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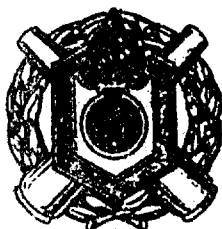
Technical Report ARAED-TR-93026

**INSTRUMENTATION FOR THE FOREIGN WEAPONS  
EVALUATION PROGRAM**

Joseph Petrellese, Jr.

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## INTRODUCTION

The objective of the Foreign Weapons Evaluation Program is to test the foreign 155-mm semiautomatic artillery loader/assist device (SAL) for performance and applicability to U.S. Army artillery systems using the M284 cannon. After a series of tests and evaluations, several SAL candidates will be narrowed down to a single system which will ultimately be recommended for procurement.

Testing was first performed using two currently accepted ramming methods, hand ramming and positive-stroke piston ramming (hydraulic ramming). These tests were performed to establish baseline values for future evaluation of semiautomatic artillery ramming devices. Testing was then conducted on three different SAL under the same test parameters as the hand and hydraulic ram tests.

Telemetry data was recorded for each and every test, with quick look data also available. A block diagram of the telemetry test setup is shown in figure 1.

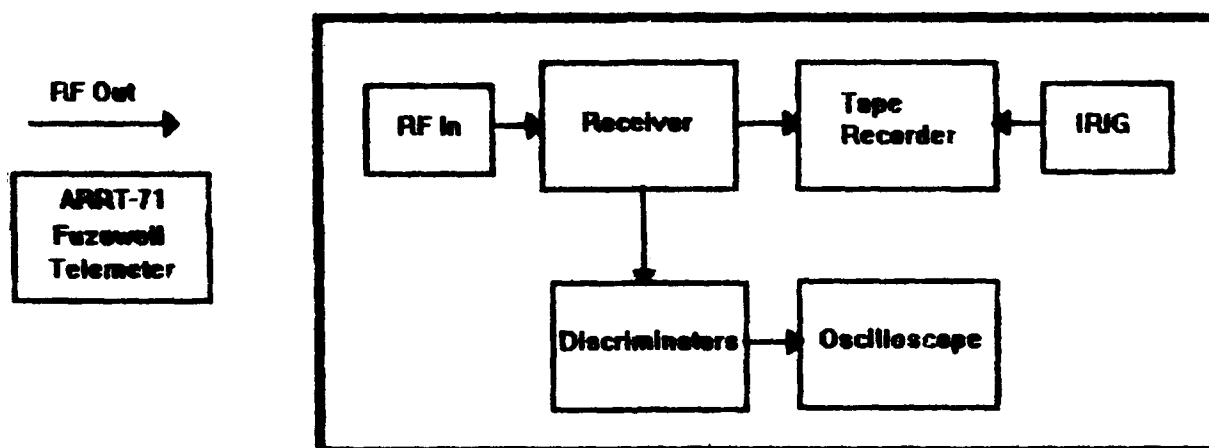


Figure 1. Telemetry test van

All tests were conducted using an ARDEC model ARRT-71 fuze well telemeter (TM). The TM consisted of a tri-axial accelerometer, transmitter, batteries, and related electronic components. A block diagram of the TM is shown in figure 2.

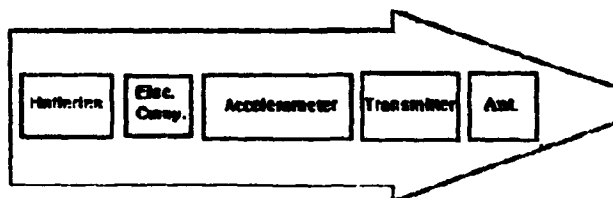


Figure 2. ARDEC model ARRT-71 fuze well telemeter



The tri-axial accelerometer was used to measure acceleration in three different axis: the traverse, vertical, and longitudinal axis.

### Testing Procedure

On all test series the test configuration was as shown in figure 3.

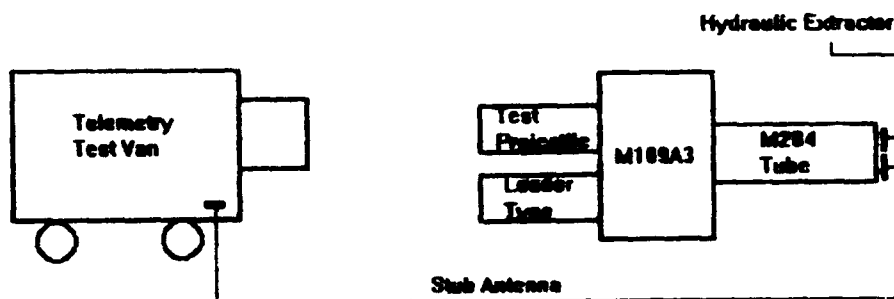


Figure 3. Test series configuration

The tests were conducted using three different inert projectile models, the M107A1, M549A1, and the M483A1. Data was recorded using each of these models at various quadrant elevation (QE) values of the howitzer. The following data was logged prior to ramming:

Vehicle type	Loader type
Vehicle serial number	Loader serial number
Tube type	Sample number
Tube serial number	Projectile number
Projectile Model	Ram number
Ram QE	

Once these parameters were recorded, an ARRT-71 TM would be installed in place of the fuze in the nose of the projectile. The round would then be placed on the loading tray. The TM was then activated to confirm TM operation and zero baseline. All data was recorded with IRIG time on 1 in. magnetic tape. Once the recorder was up

to speed the engineer would then give a 3 to 5 sec countdown to the gun crew, following which the ram would take place using either the hand ram, the hydraulic ram, or one of the SAL. Upon completion of the ram, the data was recorded for an additional 5 sec. After the round was removed from the chamber, the TM was deactivated and the peak pressure was measured. The extraction force was then calculated from the peak pressure. This procedure was repeated for the various types of loaders and projectile models used, with the data being recorded for each test. A digital oscilloscope was also used in the telemetry van, so that a quick-look analysis could be given on the ram test including the maximum longitudinal (axial) acceleration.

## **Testing Results**

A total of 288 ramming tests were performed using a hand rammer, hydraulic rammer, and three different SAL with all data recorded on magnetic tape. Data from each test was analyzed for maximum positive and negative acceleration in the transverse, vertical, and longitudinal axis for both before seating, seating, and after seating acceleration. Maximum seating velocity was also computed by integrating the longitudinal seating acceleration. A summary of all the results can be found in tables 1 through 42. For certain loader types, the before seating acceleration (balloting) measured was so small that it was not included in summary tables. Typical sample plots for each table are shown in appendixes A through D.

## **SUMMARY**

The telemetry section of the Armament Engineering Directorate working jointly with the Fire Support Armaments Center (FSAC) personnel obtained excellent quality telemetry data on all ramming tests. The data was analyzed, tabulated, plotted, and provided to FSAC for their use in determining future testing and/or procurement actions. Data was also provided to the Project Manager for Advance Field Artillery System (AFAS) for assistance in developing an AFAS loading system.

Table 1. Semiautomatic 155-mm artillery loader/assist device results, M107/264 mils/std hyd

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																						
DATE: OCT 12, 1980		VEHICLE TYPE: M109A3			TUBE TYPE: M284			PROJ MODEL: M107			LOADER TYPE: STD HYD											
SHEET # : 1		VEH SER#: 1813			TUBE SER#: 762			RAM QE: 264 mils			LOADER SER#: UNKNOWN											
SEATING ACCELERATION																						
AFTER SEATING ACCELERATION																						
		SEATING			TRANSV			VERTICAL			LONGITUDE			VERTICAL			LONGITUDE					
		EXTRA			POS			NEG			POS			NEG			POS			NEG		
SAMP	PROJ	RAM	FORCE	SEATING	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG			
#	#	#	(LBS)	(FT/SEC)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)	(G'S)			
1	1	1	12588	11.32	103	139	150	94	61	496	152	96	225	138	324	184						
2	2	1	15900	11.81	172	318	87	130	0	511	306	220	124	136	397	193						
3	3	1	15238	11.41	254	224	282	257	0	569	278	194	207	119	551	281						
4	4	1	16563	11.52	206	200	150	81	0	600	212	297	150	263	422	159						
5	5	1	14575	13.28	184	214	155	149	23	567	441	231	266	149	426	301						
6	6	1	18550	11.92	42	85	160	172	0	487	188	151	141	172	490	309						
7	7	1	14575	11.73	98	122	80	118	0	414	147	104	87	149	306	187						
8	8	1	14575	12.19	91	133	175	157	21	474	211	315	144	250	413	254						
9	9	1	12588	11.73	86	18	149	93	0	426	122	165	136	285	386	312						
10	10	1	16563	12.60	67	79	203	191	0	490	61	103	135	310	563	447						







Table 5. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/std hyd

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: OCT 12, 1990				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: STD HYD			
SHEET # : 5				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 264 mils				LOADER SER#: UNKNOWN			
				SEATING ACCELERATION								AFTER SEATING ACCELERATION							
		EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE			
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	
43	1	2	21863	12.79	139	67	263	213	0	477	109	140	163	182	955	600			
44	2	1	20538	13.08	43	80	111	142	0	608	250	214	143	180	1080	690			
45	3	1	22525	14.04	128	91	88	170	0	558	109	200	200	163	1067	715			
46	4	1	22525	12.58	67	86	161	161	0	540	116	141	111	124	958	704			
47	5	1	22194	13.34	157	115	81	88	0	568	188	145	188	163	911	823			
48	6	1	23188	12.03	104	214	173	186	0	535	135	153	80	155	862	472			
49	7	1	21863	14.54	61	151	194	194	0	636	133	115	76	113	1146	891			
50	8	1	23519	11.78	86	61	229	188	0	613	153	110	87	186	1094	794			
51	9	1	23188	12.92	73	97	162	213	0	578	103	97	69	138	1175	832			
52	10	1	22194	12.51	31	67	186	161	0	595	165	104	136	180	1112	749			

Table 6. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/hand

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																									
DATE: OCT 12, 1980					VEHICLE TYPE: M109A3					TUBE TYPE: M284					PROJ MODEL: M483					LOADER TYPE: HAND					
SHEET # : 6					VEH SER#: 1813					TUBE SER#: 782					RAM QE: 264 mils					LOADER SER#: UNKNOWN					
					SEATING ACCELERATION										AFTER SEATING ACCELERATION										
					EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE						
SAMP	PROJ	RAM	FORCE		VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG		
#	#	#	(LBS)		(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)			
53	11	1	21531		11.16	49	151	225	213	0	553	218	85	138	376	879	684								
54	12	1	16563		10.24	245	349	80	111	57	420	190	288	130	130	618	340								
55	13	1	19875		10.92	115	194	144	44	0	510	133	109	144	157	808	601								
56	14	1	20538		11.35	98	228	50	68	0	536	184	177	87	75	871	663								
57	15	1	25838		14.14	182	157	275	219	0	685	163	212	100	182	1155	813								
58	16	1	21863		11.17	196	312	105	93	0	595	196	202	142	149	812	713								
59	17	1	18213		11.70	67	85	207	213	0	524	133	151	269	200	935	729								
60	18	1	21202		11.46	245	153	130	180	0	517	177	141	136	142	844	608								
61	19	1	22856		13.17	133	91	113	44	0	587	167	145	144	157	979	891								
62	20	1	22194		13.24	98	110	167	272	0	472	86	159	167	136	753	581								



Table 7. Semiautomatic 155-mm artillery loader/assist device results, M107/264 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991		VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M107				LOADER TYPE: SAL 1					
SHEET # : 7		VEH SER#: 1813				TUBE SER#: 782				RAM QE: 264 mils				LOADER SER#: UNKNOWN					
SAMP #	PROJ #	RAM #	FORCE (LBS)	SEATING VELOCITY (FT/SEC)	SEATING ACCELERATION						AFTER SEATING ACCELERATION								
					TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE				
					POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	
63	21	1	34450	17.57	290	315	163	81	0	852	575	206	250	244	989	764			
64	22	1	33125	14.93	386	355	136	328	0	753	447	398	297	235	781	508			
65	23	1	38438	17.08	204	477	285	346	0	1150	297	290	458	180	946	937			
66	24	1	38438	18.19	0	257	200	100	0	950	777	704	470	695	1058	558			
67	25	1	35775	15.31	373	367	182	223	0	821	343	361	377	143	767	504			
68	26	1	31800	16.59	254	483	149	359	0	740	359	334	402	198	918	422			
69	27	1	33788	18.44	182	339	100	100	0	1013	345	224	670	157	886	338			
70	28	1	34450	16.20	330	416	241	365	0	767	306	288	200	167	921	704			
71	29	1	31800	17.65	87	186	235	265	0	998	668	309	786	766	2565	2307			
72	30	1	33125	14.84	224	264	319	270	0	783	442	321	401	563	1126	588			







Table 11. Semiautomatic 155-mm artillery loader/assist device results, M549/264 mils/SAL 1

FOREIGN COMPARATIVE TESTING SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET														
DATE: JAN 7, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M284				
SHEET # : 11					VEH SER#: 1813					TUBE SER#: 7d2				
										RAM QE: 264 mils				
										LOADER SER#: UNKNOWN				
					SEATING ACCELERATION					AFTER SEATING ACCELERATION				
					EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE	
					RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS
					#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)
88	21	1	27163	12.72	129	190	280	192	0	1039	226	239	254	186
89	22	1	28488	13.98	241	551	272	229	0	1143	241	272	229	241
90	23	1	28488	14.98	91	121	150	194	0	803	321	315	188	138
91	24	1	27825	13.98	92	239	246	167	0	882	171	116	279	235
92	25	1	27825	16.41	87	309	105	217	0	768	322	210	173	192
93	26	1	33788	15.05	163	115	107	100	0	533	208	170	757	551
94	27	1	34450	14.70	135	245	161	198	0	599	233	226	217	217
95	28	1	35775	14.28	167	551	272	280	0	1253	365	576	303	297
96	29	1	29813	15.00	85	91	125	207	0	592	194	67	175	257
97	30	1	28488	13.27	275	208	118	105	0	586	251	190	149	316
														456
														522

Table 12. Semiautomatic 155-mm artillery loader/assist device results, M549/600 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M549				LOADER TYPE: SAL 1			
SHEET # : 12				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 600 mils				LOADER SER#: UNKNOWN			

Table 13. Semiautomatic 155-mm artillery loader/assist device results, M549/900 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																
DATE: JAN 7, 1991			VEHICLE TYPE: M109A3			TUBE TYPE: M284			PROJ MODEL: M549			LOADER TYPE: SAL 1				
SHEET # : 13			VEH SER#: 1813			TUBE SER#: 762			RAM QE: 900 mls			LOADER SER#: UNKNOWN				
SAMP #	PROJ #	RAM #	EXTRA FORCE (LBS)	SEATING VELOCITY (FT/SEC)	SEATING ACCELERATION				AFTER SEATING ACCELERATION							
					TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE	
					POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG
103	36	1	25838	13.07	177	208	62	111	0	812	202	263	124	155	849	404
104	37	1	30475	13.88	186	93	136	235	0	670	241	248	303	167	651	417
105	38	1	32463	14.03	109	133	200	200	0	514	145	224	282	207	720	641
106	39	1	32463	11.78	190	73	142	192	0	462	196	128	186	229	536	275
107	40	1	27163	13.04	136	149	142	99	0	644	105	93	124	155	489	252

Table 14. Semiautomatic 155-mm artillery loader/assist device results, M549/0 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M549				LOADER TYPE: SAL 1			
SHEET # : 14				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 0 mls				LOADER SER#: UNKNOWN			



Table 15. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7,1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 1			
SHEET # : 15				VEH SER#: 1813				TUBE SER#: 782				RAM OE: 264 mils				LOADER SER#: UNKNOWN			
				SEATING ACCELERATION								AFTER SEATING ACCELERATION							
				EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE	
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	
113	21	1	33125	17.71	353	235	188	210	0	925	452	526	241	309	1722	1042			
114	22	1	34450	19.80	242	176	113	138	0	1065	127	272	413	200	1469	1542			
115	23	1	35113	17.16	229	165	142	93	0	919	477	447	192	167	1804	1418			
116	24	1	31800	15.68	37	99	272	285	0	925	223	328	173	217	1792	1628			
117	25	1	34450	19.83	339	176	213	75	0	893	127	133	144	169	1775	1922			
118	26	1	32463	15.16	245	184	179	192	0	874	220	226	192	173	1850	1237			
119	27	1	35113	18.87	118	149	254	192	0	972	279	217	174	241	2003	1300			
120	28	1	34450	19.87	145	151	125	119	0	1114	188	157	351	213	2020	1824			
121	29	1	34450	16.33	171	104	210	254	0	685	171	220	167	167	930	994			
122	30	1	31138	16.60	81	229	229	272	0	937	415	216	253	217	759	637			



Table 17. Semiautomatic 155-mm artillery loader/assist device results, M483/600 mils/SAL 1

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JAN 7, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 1			
SHEET # : 17				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 600 mils				LOADER SER#: UNKNOWN			
SAMP #	PROJ #	RAM #	FORCE (LBS)	SEATING VELOCITY (FT/SEC)	SEATING ACCELERATION				AFTER SEATING ACCELERATION				LONGITUDE	VELOCITY	TRANSV.	VERTICAL	POS	NEG	LONGITUDE
					SEATING	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS
128	36	1	32463	19.58	99	217	155	93	0	949	408	205	149	186	2050	2214			
129	37	1	35775	20.68	290	139	250	100	0	942	224	157	232	338	1799	1922			
130	38	1	34450	18.58	110	104	124	118	0	873	153	122	179	248	1895	1350			
131	39	1	36438	19.12	105	198	303	421	0	902	458	309	260	229	1698	1933			
132	40	1	33125	18.55	200	121	125	150	0	673	133	67	119	106	844	1359			







Table 21. Semiautomatic 155-mm artillery loader/assist device results, M107/600 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M204				PROJ MODEL: M107				LOADER TYPE: SAL 2			
SHEET # : 21				VEH SER#: 1813				TUBE SER#: 782				RAM OF: 600 mils				LOADER SER#: UNKNOWN			
SAMP	PROJ	RAM	FORCE	EXTRA	BEFORE SEATING ACCELERATION				SEATING ACCELERATION				AFTER SEATING ACCELERATION				POS	NEG	LONGITUDE
					SEATING	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	POS	NEG	LONGITUDE
#	#	#	(LBS)	(FT/SEC)	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG
					(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)
163	61	1	45050	26.61	776	927	676	282	330	336	508	426	300	0	1136	242	281	476	1678
165	62	2	38088	20.17	1004	1004	942	284	238	208	318	495	371	0	896	342	284	421	198
168	63	1	38425	22.19	584	322	485	371	141	187	644	782	844	0	1078	371	782	883	788
167	64	1	19875	9.80	567	412	428	378	122	147	1088	981	751	0	638	121	702	801	514
168	65	1	47038	23.13	581	563	1411	1411	488	634	538	584	470	0	896	387	416	272	851
																			510

Table 22. Semiautomatic 155-mm artillery loader/assist device results, M107/1000 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M204				PROJ MODEL: M107				LOADER TYPE: SAL 2							
SHEET # : 22				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 1000 mils				LOADER SER#: UNKNOWN							



Table 23. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																				
DATE: JUN 24, 1991				VEHICLE TYPE: M109A1				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 2				
SHEET # : 23				VEH SER#: 1813				TUBE SER#: 782				RAM DE: 264 mils				LOADER SER#: UNKNOWN				
SAMP	PROJ	RAM	EXTRA	SEATING	BEFORE SEATING ACCELERATION				SEATING ACCELERATION				AFTER SEATING ACCELERATION				LONGITUDE	POS	NEG	LONGITUDE
					FORCE	VELOCITY	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.				
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	POS	NEG	(g's)	(g's)	POS	NEG	(g's)	(g's)	POS	NEG	(g's)	(g's)	(g's)	
104	46	1	57638	31.50	416	661	470	545	250	186	294	223	223	248	272	2806	2859			
105	47	1	57638	32.18	1077	458	520	371	340	235	285	619	449	408	421	3010	2840			
106	48	1	56550	30.08	808	1270	701	927	807	832	264	303	801	526	448	376	3133	3064		
107	49	1	56975	28.76	404	378	545	448	227	204	257	428	421	551	421	371	2383	1498		
108	50	1	61613	32.07	1040	520	470	668	445	445	173	272	223	3169	1188	1486	2899	2202		
109	51	1	56963	31.00	557	436	560	761	367	362	169	145	576	242	501	501	3133	2688		
170	52	1	60250	31.45	367	343	828	804	409	489	122	122	458	318	359	681	2804	2632		
141	53	1	56650	28.74	396	421	584	371	234	351	297	644	124	618	743	584	2647	2272		
172	54	1	56313	26.73	254	302	276	276	245	186	327	302	426	157	401	276	1071	685		
173	55	1	56650	23.58	367	284	346	223	182	136	220	294	248	220	89	173	817	613		

\* Output Clipped (maximum output of Accelerometer obtained)  
 Projectiles #46-53 have thick bases  
 Projectiles #54-55 have normal bases

Table 24. Semiautomatic 155-mm artillery loader/assist device results, M483/0 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 2							
SHEET # : 24				VEH SER#: 1813				TUBE SER#: 782				RAM QE: 0 mils				LOADER SER#: UNKNOWN							

Table 25. Semiautomatic 155-mm artillery loader/assist device results, M483/600 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																								
DATE: JUN 24, 1991					VEHICLE TYPE: M108A3					TUBE TYPE: M284					PROJ MODEL: M483					LOADER TYPE: SAL 2				
SHEET # : 26					VEH SER#: 1813					TUBE SER#: 782					RAM OE: 600 mils					LOADER SER#: UNKNOWN				
SAMP #	PROJ #	RAM #	FORCE (LBS)	VELOCITY (FT/SEC)	BEFORE SEATING ACCELERATION				SEATING ACCELERATION				AFTER SEATING ACCELERATION											
					EXTRA	SEATING	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE
179	01	1	55650	28.34	416	293	384	235	227	196	220	268	532	433	0	1878	318	343	260	359	2905	2859		
180	02	1	57638	28.53	582	334	607	557	223	248	334	384	384	308	0	1558	334	359	831	409	2776	2846		
181	03	1	56875	31.08	208	133	881	826	257	267	278	278	278	76	0	1877	351	303	200	200	3121	1359		
182	04	1	42400	26.00	607	433	520	782	351	482	384	681	817	782	0	1078	285	235	124	98	679	679		
183	05	1	47700	21.86	308	845	421	421	277	182	355	502	186	386	0	882	134	257	188	223	1203	1180		

Table 26. Semiautomatic 155-mm artillery loader/assist device results, M483/1000 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																			
DATE: JUN 24, 1991		VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 2					
SHEET # : 28		VEH SER#: 1813				TUBE SER#: 782				RAM CE: 1000 mils				LOADER SER#: UNKNOWN					

Table 27. Semiautomatic 155-mm artillery loader/assist device results, M549/264 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																								
DATE: JUN 24, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M204					PROJ MODEL: M549					LOADER TYPE: SAL 2				
SHEET # : 27					VEH SER#: 1813					TUBE SER#: 782					RAM QE: 264 mls					LOADER SER#: UNKNOWN				
SAMP #	PROJ #	RAM #	EXTRA	SEATING VELOCITY (FT/SEC)	BEFORE SEATING ACCELERATION			SEATING ACCELERATION			AFTER SEATING ACCELERATION			LONGITUDE	VERTICAL	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS
					TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE											
189	46	1	37763	24.09	1337	966	1077	978	897	618	297	260	334	0	949	868	594	161	210	808	621			
190	47	1	36438	22.86	448	448	388	383	428	232	230	208	238	0	1183	376	187	413	213	771	748			
191	48	1	30476	16.41	598	539	446	471	227	318	343	371	173	0	817	171	171	248	173	999	645			
192	49	1	35113	19.45	893	347	285	483	178	223	584	421	557	137	0	1013	396	248	285	235	999	433		
193	50	1	30476	19.62	606	847	864	588	638	367	218	218	288	213	0	979	281	97	138	213	734	583		
194	51	1	33788	18.28	838	418	828	878	378	328	220	288	334	805	0	1032	343	318	334	334	824	374		
195	52	1	27826	17.47	368	148	347	371	184	308	297	347	818	173	0	728	322	74	272	173	538	234		
196	53	1	41075	24.58	728	605	551	578	282	287	412	798	428	150	0	1383	387	315	275	351	747	1040		
197	54	1	36438	18.85	480	288	408	508	183	183	220	288	582	210	0	887	288	343	210	138	682	888		
198	55	1	17225	10.53	388	188	470	322	187	281	271	148	272	348	0	773	148	50	124	188	422	211		

Table 28. Semiautomatic 155-mm artillery loader/assist device results, M549/0 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET														
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3		TUBE TYPE: M284		PROJ MODEL: M549		LOADER TYPE: SAL 2				
SHEET # : 28				VEH SER#: 1813		TUBE SER#: 782		RAM QE: 0 m/s		LOADER SER#: UNKNOWN				

Table 29. Semiautomatic 155-mm artillery loader/assist device results, M549/600 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																						
DATE: JUN 24, 1991			VEHICLE TYPE: M109A3			TUBE TYPE: M264			PROJ MODEL: M549			LOADER TYPE: SAL 2										
SHEET # : 20			VEH SER#: 1813			TUBE SER#: 782			RAM QD: 600 mils			LOADER SER#: UNKNOWN										
			BEFORE SEATING ACCELERATION						SEATING ACCELERATION						AFTER SEATING ACCELERATION							
			EXTRA	SEATING	TRANSV	VERTICAL	LONGITUDE	TRANSV	VERTICAL	LONGITUDE	TRANSV	VERTICAL	LONGITUDE	TRANSV	VERTICAL	LONGITUDE	TRANSV	VERTICAL	LONGITUDE			
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG		
θ	θ	θ	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)		
204	01	1	410/15	23.48	743	584	1102	1473	326	306	371	767	186	384	0	1268	782	569	408	188	679	
205	02	1	38776	18.38	581	606	608	758	284	343	436	218	163	213	0	881	242	242	289	313	538	
206	03	1	40413	19.40	387	288	280	631	188	182	387	288	409	236	0	885	220	198	210	111	545	
207	04	1	21200	11.18	2080	3144	1708	3144	587	2840	223	189	124	74	0	457	248	198	272	371	551	
208	05	1	38776	18.31	436	363	338	288	308	209	484	218	88	138	0	1016	188	194	236	336	404	

\* Output Clipped (maximum output of Accelerometer obtained)

Table 30. Semiautomatic 155-mm artillery loader/assist device results, M549/1000 mils/SAL 2

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: JUN 24, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M264				PROJ MODEL: M649				LOADER TYPE: SAL 2							
SHEET # : 30				VEH SER#: 1813				TUBE SER#: 782				RAM OE: 1000 mls				LOADER SER#: UNKNOWN							

\* Output Clipped (maximum output of Accelerometer obtained)



Table 31. Semiautomatic 155-mm artillery loader/assist device results, M107/600 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																								
DATE: OCT 2, 1981					VEHICLE TYPE: M109A3					TUBE TYPE: M284					PROJ MODEL: M107					LOADER TYPE: SAL 3				
SHEET # : 31					VSM SRM: 1813					TUBE SRM: 782					RAM CE: 800 mils					LOADER SRM: UNKNOWN				
BAMP	PROJ	RAM	EXTRA	SEATING VELOCITY (FT/SEC)	BEFORE SEATING ACCELERATION						SEATING ACCELERATION						AFTER SEATING ACCELERATION							
					TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE			
					POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG		
214	87	1	36778	24.28	584	983	1316	1038	330	358	363	828	283	287	0	84°	383	353	138	238	1877	771		
216	88	1	36778	20.78	282	378	308	404	81	81	404	477	428	404	0	1087	308	233	308	282	1338	636		
216	88	1	36778	22.38	1283	1084	718	1086	281	224	287	888	371	248	0	1101	322	287	322	347	1670	482		
217	80	1	33128	21.81	870	488	421	888	223	128	347	470	388	470	0	1131	188	188	223	173	828	434		
218	81	1	34480	22.82	1077	884	1218	813	404	330	303	381	838	884	0	1040	811	848	283	438	1481	887		

Table 32. Semiautomatic 155-mm artillery loader/assist device results, M107/264 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																													
DATE: OCT 2, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M264					PROJ MODEL: M107					LOADER TYPE: SAL 3									
SHEET # : 32					VEH SER#: 1813					TUBE SER#: 782					RAM QE: 264 mils					LOADER SER#: UNKNOWN									
					</																								

Table 33. Semiautomatic 155-mm artillery loader/assist device results, M107/0 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																						
DATE: OCT 2, 1991		VEHICLE TYPE: M109A3		TUBE TYPE: M284		PROJ MODEL: M107		LOADER TYPE: SAL 3														
SHEET # : 33		VSH GEN#: 1013		TUBE GEN#: 792		RAM GEN: 0 mls		LOADER GEN#: UNKNOWN														
SAMP	PROJ	RAM	FORCE	EXTRA	BEFORE BEATING ACCELERATION				BEATING ACCELERATION				AFTER BEATING ACCELERATION									
					BEATING	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE					
					VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)
229	102	1	40413	22.81	864	844	820	926	189	293	141	1018	1497	1820	0	1746	1144	446	1300	1126	808	340
230	103	1	27826	24.67	638	392	488	369	236	170	416	367	236	286	0	866	122	166	161	308	866	367
231	104	1	38113	24.86	866	796	796	614	206	136	836	303	666	366	0	816	327	520	313	263	1040	477
232	106	1	38640	21.81	820	477	567	1037	216	236	1016	722	1077	1226	0	1101	666	824	1161	608	861	367
233	108	1	36086	26.36	842	1267	661	1374	263	246	466	841	1003	1466	0	1206	644	366	730	266	866	367

Table 34. Semiautomatic 155-mm artillery loader/assist device results, M107/750 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASST DEVICES RESULT SHEET																			
DATE: OCT 2, 1991		VEHICLE TYPE: M108A3		TUBE TYPE: M204		PROJ MODEL: M107		LOADER TYPE: SAL 3											
SHEET # : 34		VEH SER#: 1813		TUBE SER#: 782		RAM CE: 750 mils		LOADER SER#: UNKNOWN											

Table 35. Semiautomatic 155-mm artillery loader/assist device results, M483/0 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																											
DATE: OCT 2, 1981				VEHICLE TYPE: M108A3				TUBE TYPE: M284				PROJ MODEL: M483				LOADER TYPE: SAL 3											
SHEET # : 35				VEH SER#: 1813				TUBE SER#: 782				RAM CE: 0 mls				LOADER SER#: UNKNOWN											
SLAMP	PROJ	RAM	EXTRA	BEFORE SEATING ACCELERATION								SEATING ACCELERATION								AFTER SEATING ACCELERATION							
				SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE					
				VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG			
#	#	#	(LBS)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)				
239	71	1	50075	28.41	318	508	338	338	172	250	318	338	438	488	0	1188	184	121	288	338	892	440					
240	72	1	48383	23.88	248	288	238	188	125	102	147	88	488	334	0	842	318	171	308	280	842	824					
241	73	1	50850	33.00	458	287	288	334	210	238	184	408	238	111	0	1873	342	388	388	280	3188	3132					
242	74	1	50313	31.58	233	232	248	371	114	112	478	338	182	182	0	1823	471	801	282	247	3087	2780					
243	75	1	50883	28.06	358	403	248	371	138	134	287	404	322	421	0	1827	233	330	321	272	3024	2284					

\* Output Clipped (maximum output of Accelerometer obtained)  
 Projectiles #71-72 have normal bases  
 Projectiles #73-75 have thick bases

Table 36. Semiautomatic 155-mm artillery loader/assist device results, M483/264 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																													
DATE: OCT 2, 1991										VEHICLE TYPE: M109A3					TUBE TYPE: M284					PROJ MODEL: M483					LOADER TYPE: SAL 3				
SHEET # : 36										VEH SER#: 1813					TUBE SER#: 782					RAM CE: 264 mm					LOADER SER#: UNKNOWN				
															</														

Table 37. Semiautomatic 155-mm artillery loader/assist device results, M483/600 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																								
DATE: OCT 2, 1981					VEHICLE TYPE: M109A3					TUBE TYPE: M284					PROJ MODEL: M483					LOADER TYPE: SAL 3				
SHEET # : 37					VEH SER#: 1013					TUBE SER#: 762					RAM CE: 600 mils					LOADER SER#: UNKNOWN				
SAMP	PROJ	RAM	FORCE	EXTRA	BEFORE SEATING ACCELERATION				SEATING ACCELERATION				AFTER SEATING ACCELERATION				POS	NEG	POS	NEG	POS	NEG	POS	NEG
					SEATING	TRANSP.	VERTICAL	LONGITUDE	TRANSP.	VERTICAL	LONGITUDE	TRANSP.	VERTICAL	LONGITUDE	TRANSP.	VERTICAL								
					VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS								
g	g	g	(LBS)		(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)
254	83	1	44398		20.80	278	351	276	351	276	351	73	68	230	254	250								
266	84	1	42400		17.91	233	261	267	223	46	67	404	232	308	297	0	830	208	330	297	248	1272	1187	
266	85	1	43083		25.74	188	161	334	607	117	141	607	433	206	532	0	1548	285	308	507	483	2248	2014	
267	12	2	48375		26.26	81	84	413	436	72	88	680	388	413	538	0	1843	303	253	313	338	2886	2425	
268	13	2	48038		23.18	233	308	296	384	137	188	184	188	226	508	0	1318	286	308	181	587	2808	2018	

\* Output Clipped (maximum output of Accelerometer obtained)

Projectiles #83-84, 86, 87 have normal bases

Projectiles #85, 88, 12-14, 16 have thick bases





Table 39. Semiautomatic 155-mm artillery loader/assist device results, M549/264 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																																			
DATE: OCT 2, 1991				VEHICLE TYPE: M109A3				TUBE TYPE: M284				PROJ MODEL: M549				LOADER TYPE: SAL 3																			
SHEET 6 : 39				VSH SER#: 18113				TUBE SER#: 782				RAM CE: 264 mils				LOADER SER#: UNKNOWN																			
BEFORE SEATING ACCELERATION												SEATING ACCELERATION												AFTER SEATING ACCELERATION											
EXTRA		SEATING		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE		TRANSV.		VERTICAL		LONGITUDE									
SAMP	PROJ	RAM	FORCE	VELOCITY	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG	POS	NEG							
$\theta$	$\phi$	$\theta$	(LB/IN)	(FT/SEC)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)	(g's)							
264	71	1	35778	18.08	331	452	470	398	102	124	180	232	223	124	0	824	180	188	297	420	868	351													
265	72	1	35778	23.84	384	458	390	409	89	105	235	483	433	188	0	908	260	483	188	334	574	851													
266	73	1	37100	22.82	382	278	212	288	87	123	207	277	338	183	0	736	278	180	237	288	880	417													
267	74	1	31138	17.80	331	427	488	881	171	238	180	232	235	308	0	801	234	232	181	188	488	183													
268	75	1	37108	23.10	805	807	336	181	308	375	238	238	280	210	0	887	260	334	338	188	788	518													
269	76	1	40413	21.72	284	381	438	838	188	233	278	381	338	283	0	788	288	284	438	288	1018	878													
270	77	1	42400	20.00	803	427	388	388	88	108	331	305	280	285	0	788	331	878	483	488	788	318													
271	78	1	37783	20.01	881	978	488	238	308	422	188	384	238	188	0	738	210	188	238	280	837	482													
272	79	1	48713	24.88	170	217	188	188	48	74	170	188	283	282	0	868	281	183	208	282	880	780													
273	80	1	48080	19.88	603	624	334	388	137	188	627	330	433	181	0	748	478	288	433	288	704	821													

Table 40. Semiautomatic 155-mm artillery loader/assist device results, M549/600 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																								
DATE: OCT 2, 1991					VEHICLE TYPE: M109A3					TUBE TYPE: M284					PROJ MODEL: M449					LOADER TYPE: SAL 3				
SHEET # : 40					VEH SER#: 1813					TUBE SER#: 782					RAM CE: 600 mls					LOADER SER#: UNKNOWN				

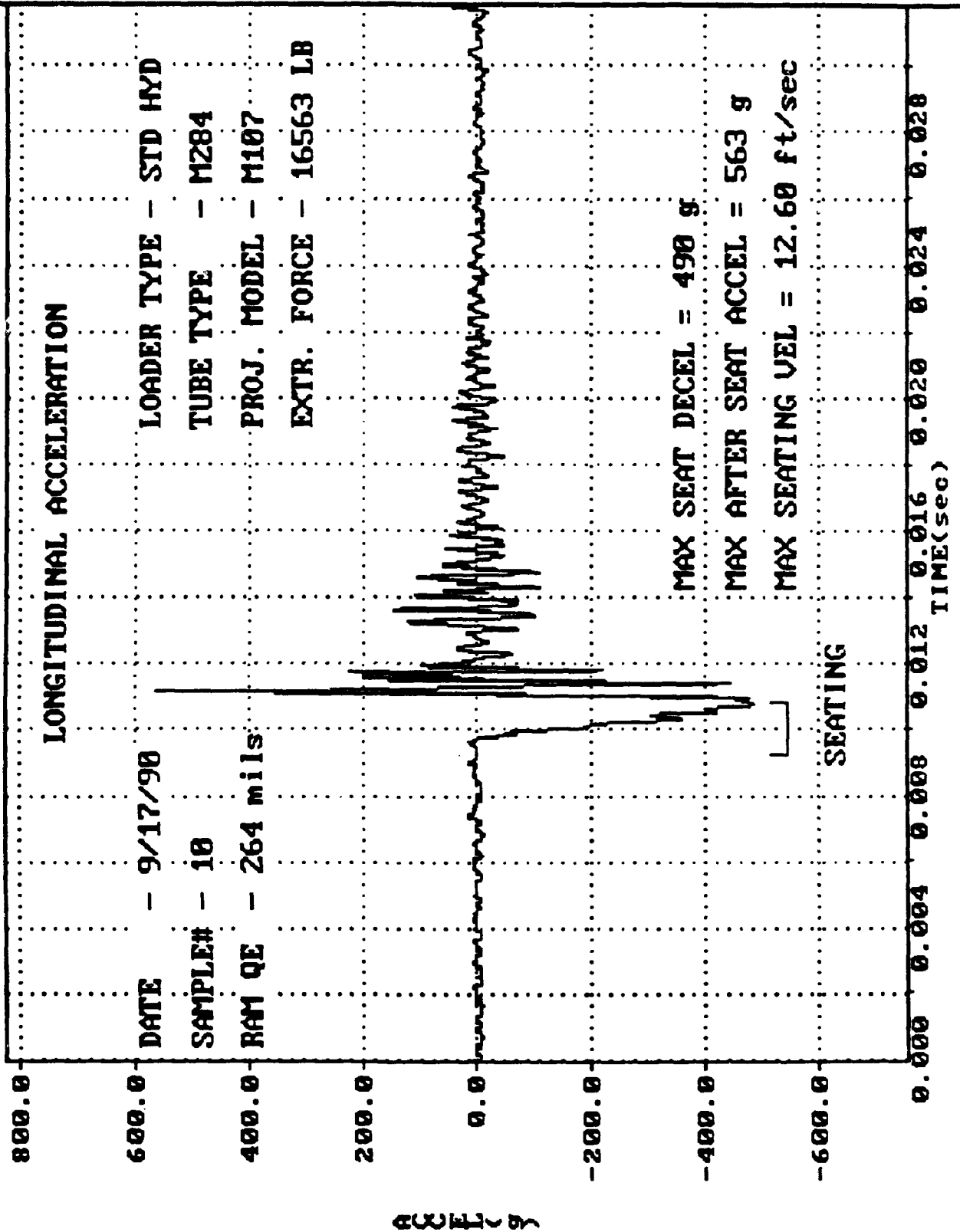
Table 41. Semiautomatic 155-mm artillery loader/assist device results, M549/750 mils/SAL 3

FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC 155 mm ARTILLERY LOADER/ASSIST DEVICES RESULT SHEET																							
DATE: OCT 2, 1981			VEHICLE TYPE: M109A3			TUBE TYPE: M284			PROJ MODEL: M549			LOADER TYPE: SAL 3											
SHEET # : 41			VBI SER#: 1813			TUBE SER#: 792			RAM OE: 750 mile			LOADER SER#: UNKNOWN											
SAMP	PROJ	RAM	FORCE (LBS)	EXTRA	BEFORE SEATING ACCELERATION						SEATING ACCELERATION						AFTER SEATING ACCELERATION						
					SEATING	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE	TRANSV.	VERTICAL	LONGITUDE						
					VELOCITY (FT/SEC)	POS (g's)	NEG (g's)	POS (g's)	NEG (g's)	POS (g's)	NEG (g's)	POS (g's)	NEG (g's)	POS (g's)	NEG (g's)	POS (g's)	NEG (g's)	POS (g's)	NEG (g's)	POS (g's)	NEG (g's)		
278	88	1	43088		18.82	221	268	388	384	381	88	97	808	832	0	727	172	186	408	433	824	374	
280	87	1	35778		18.10	832	842	384	808	83	117	211	188	288	100	0	878	384	334	308	138	884	328
281	88	1	43728		20.08	184	242	483	738	244	187	281	314	413	338	0	880	184	217	388	438	838	888
282	88	1	42400		18.48	180	183	210	280	114	80	186	363	210	280	0	728	282	328	238	280	888	488
283	80	1	38428		20.41	223	173	238	388	47	70	287	322	181	238	0	843	322	248	280	288	888	288

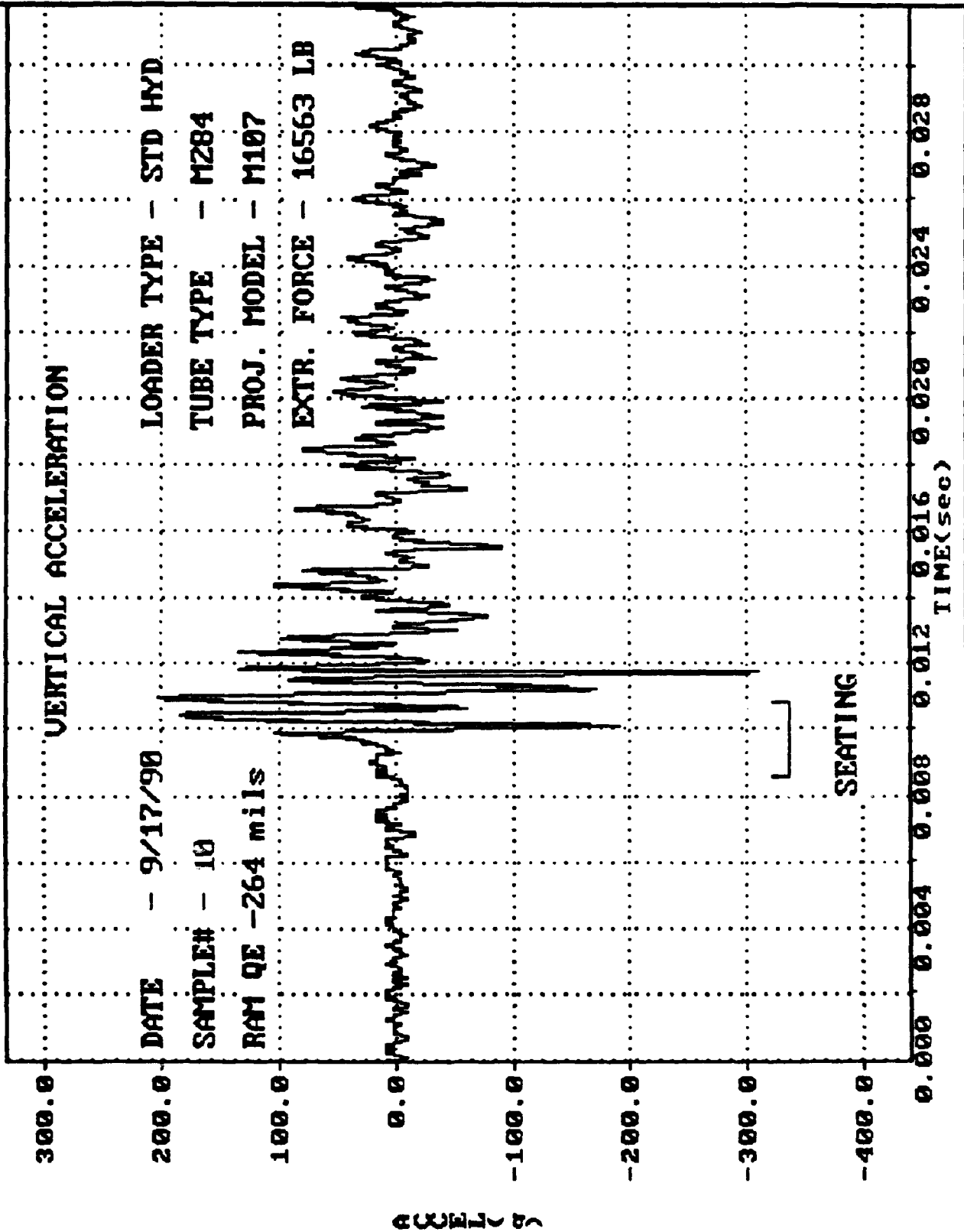


**APPENDIX A**  
**HAND AND HYDRAULIC RAMS**

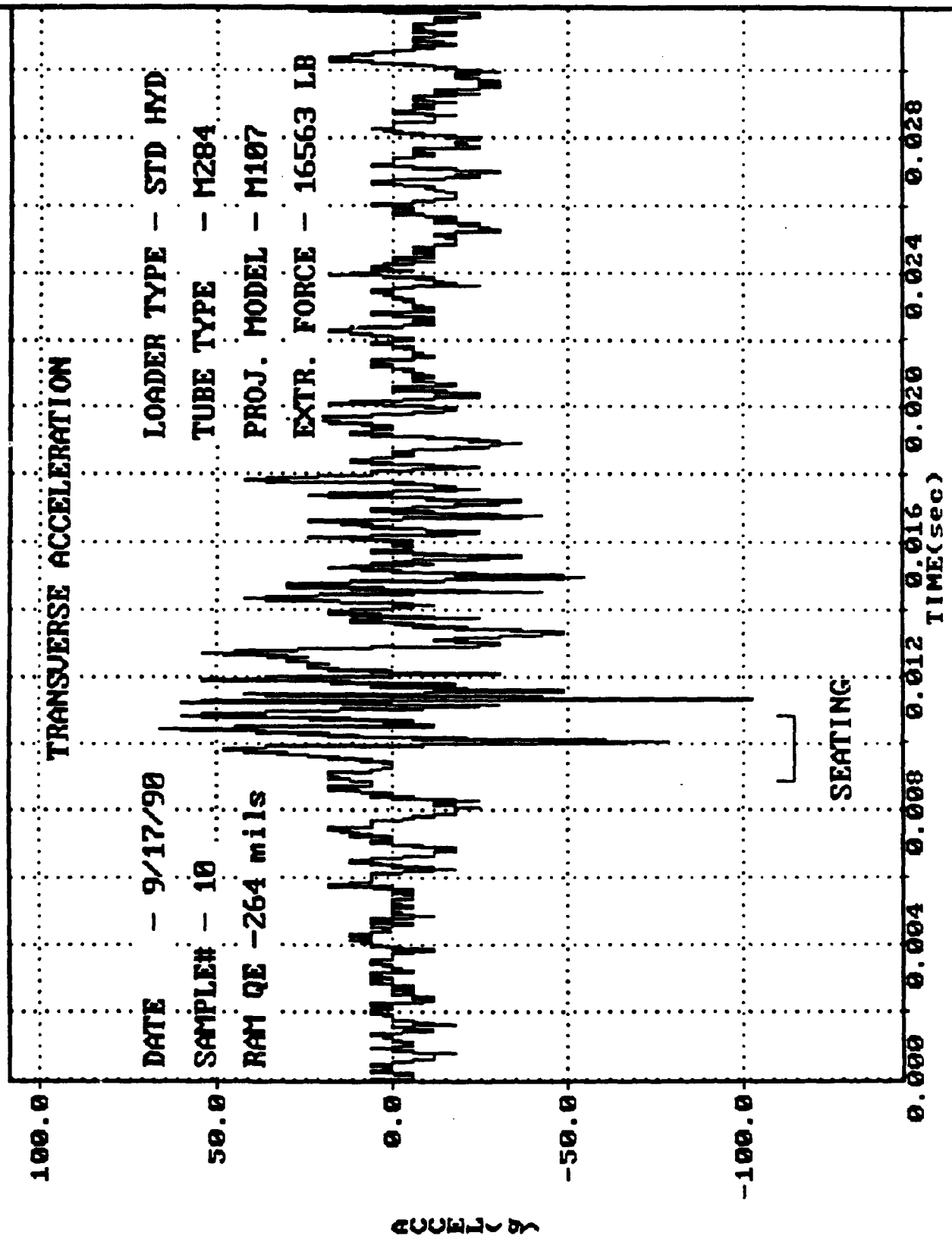
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# FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS

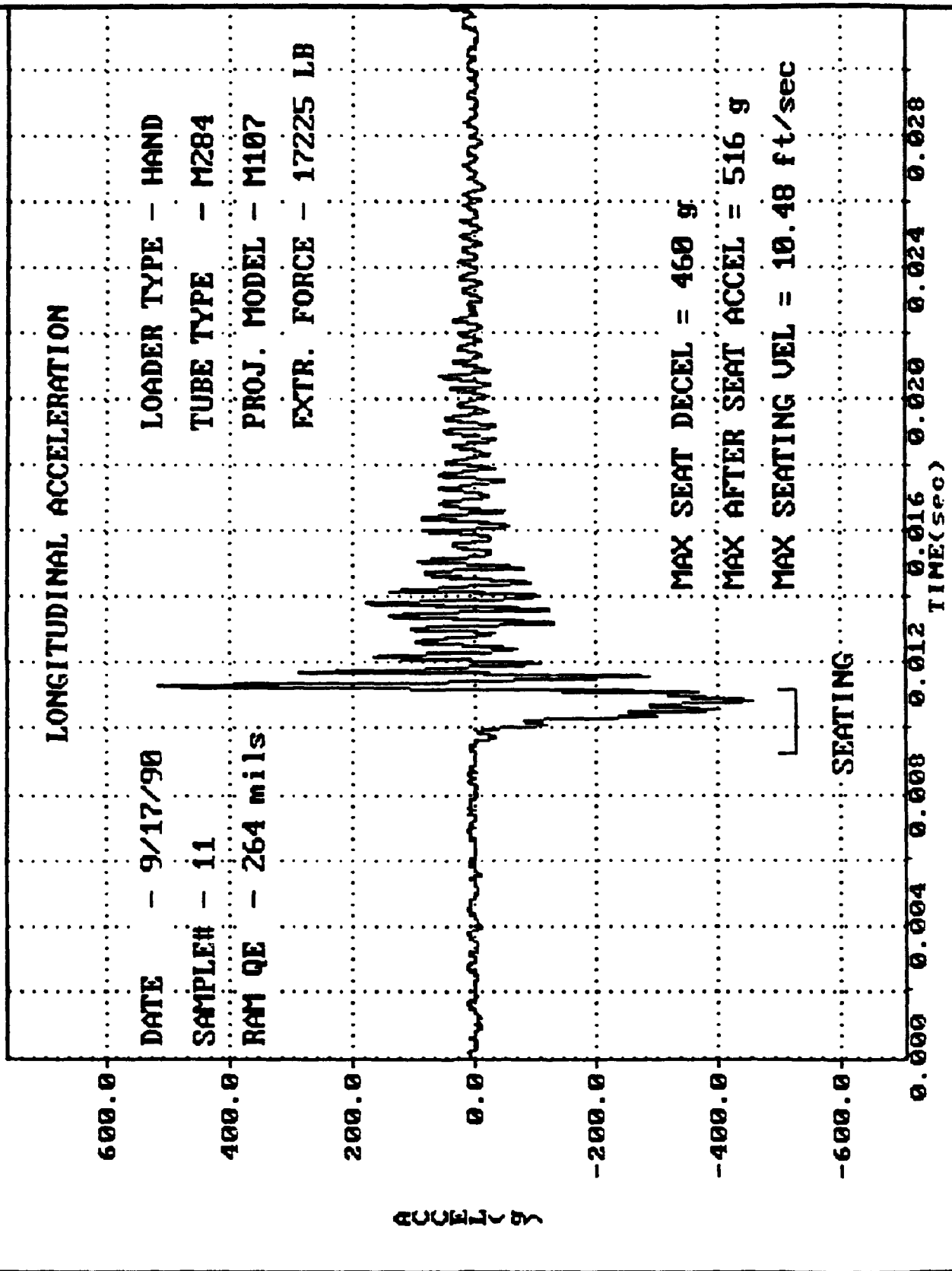


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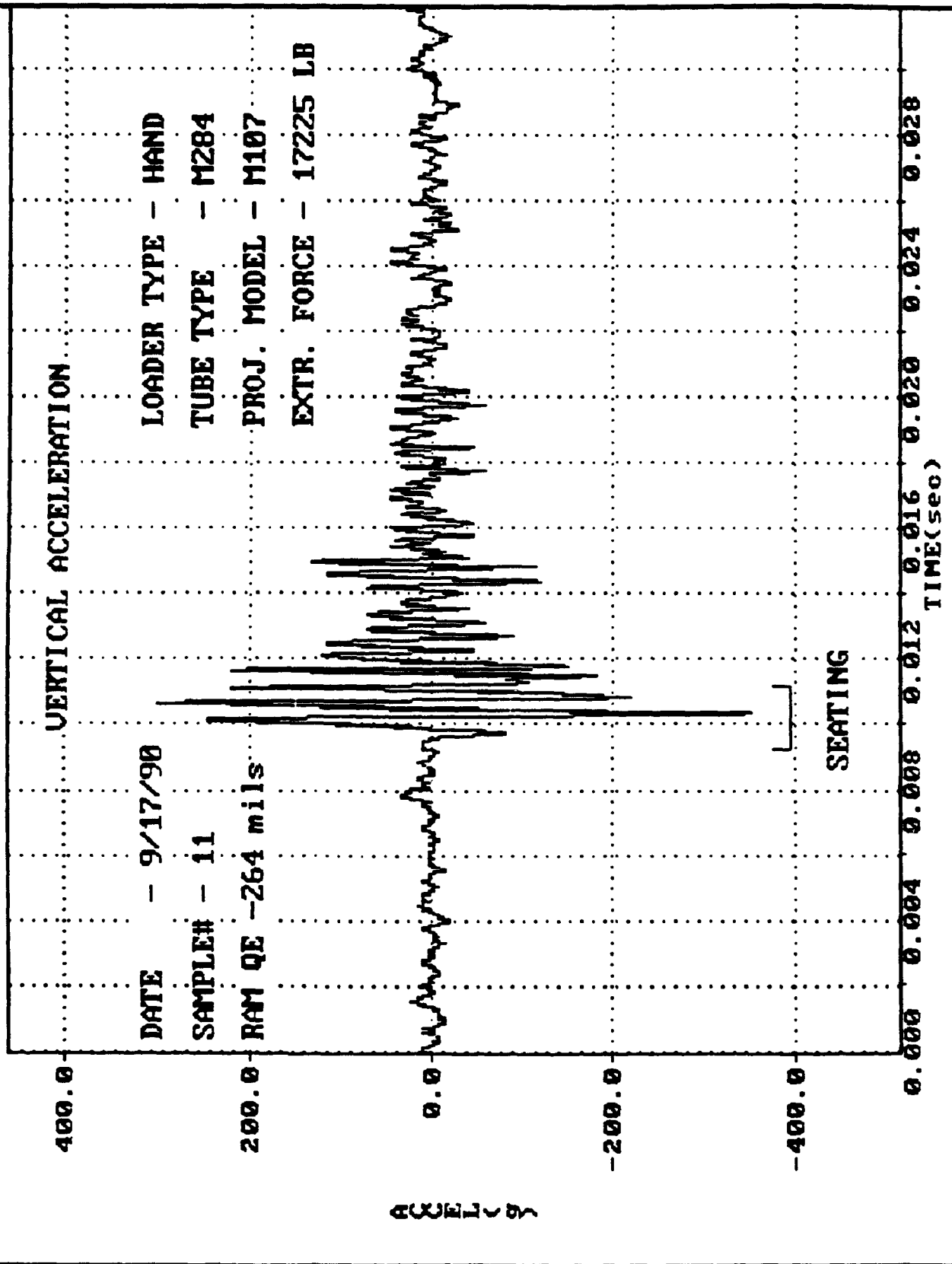




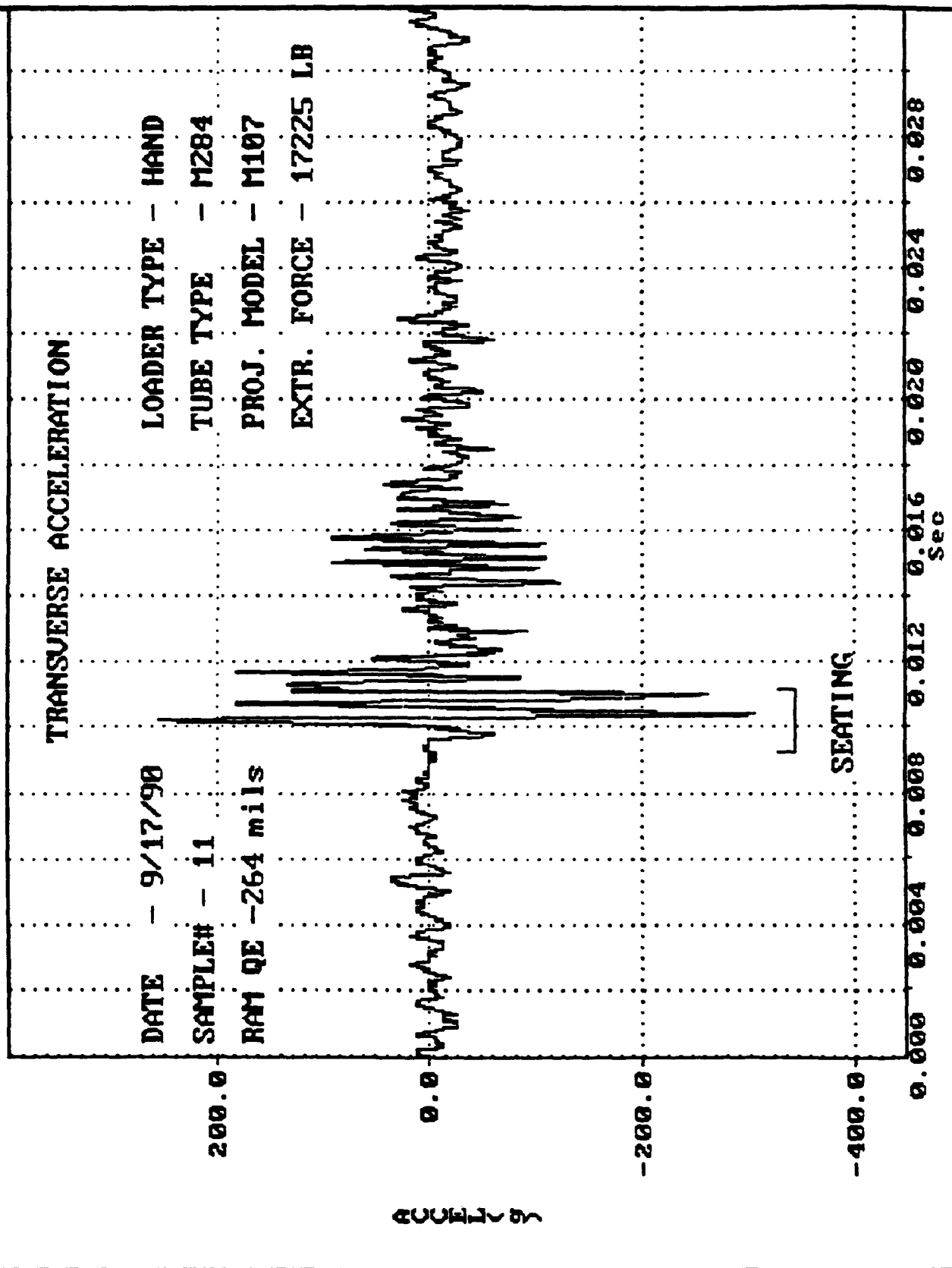
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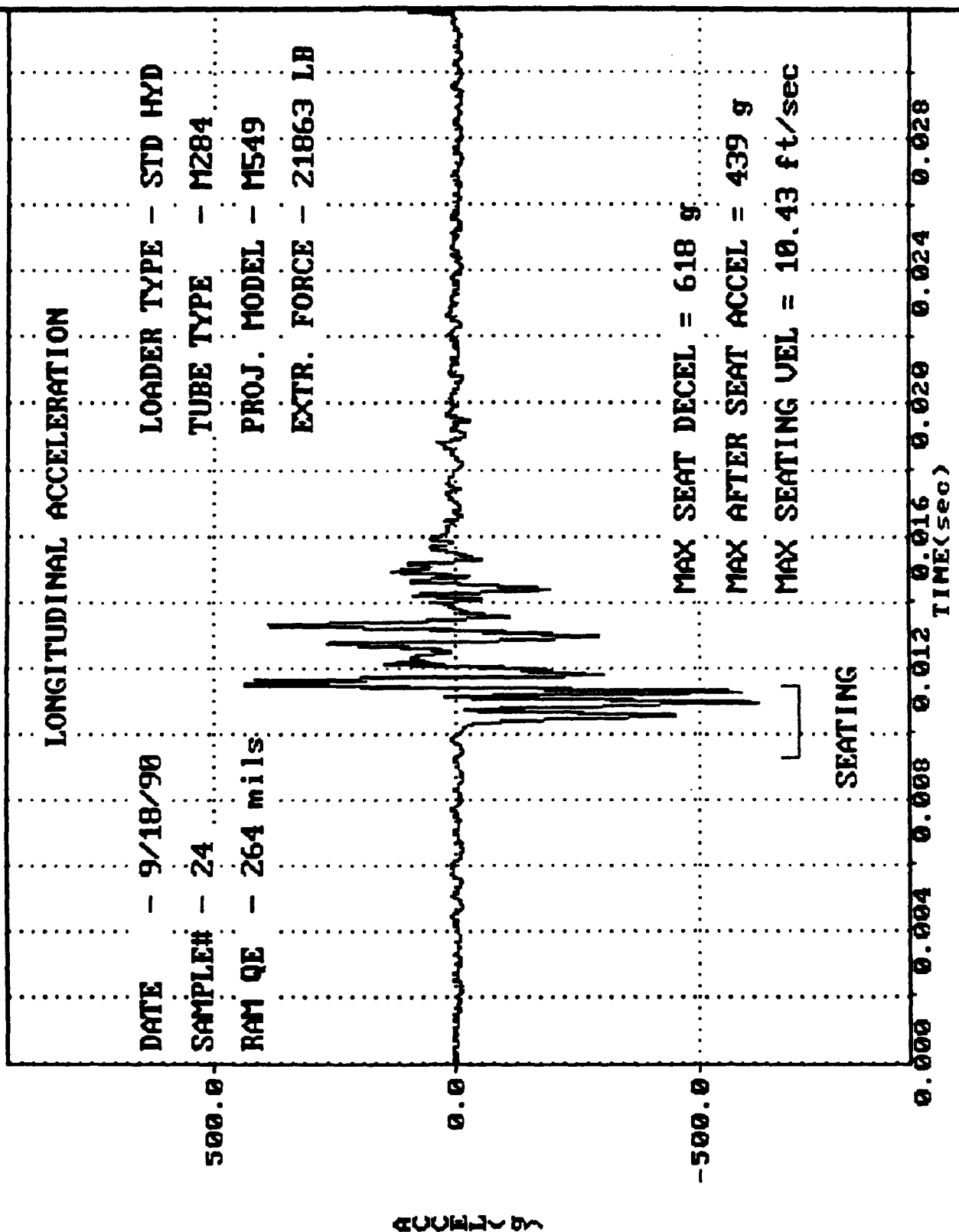
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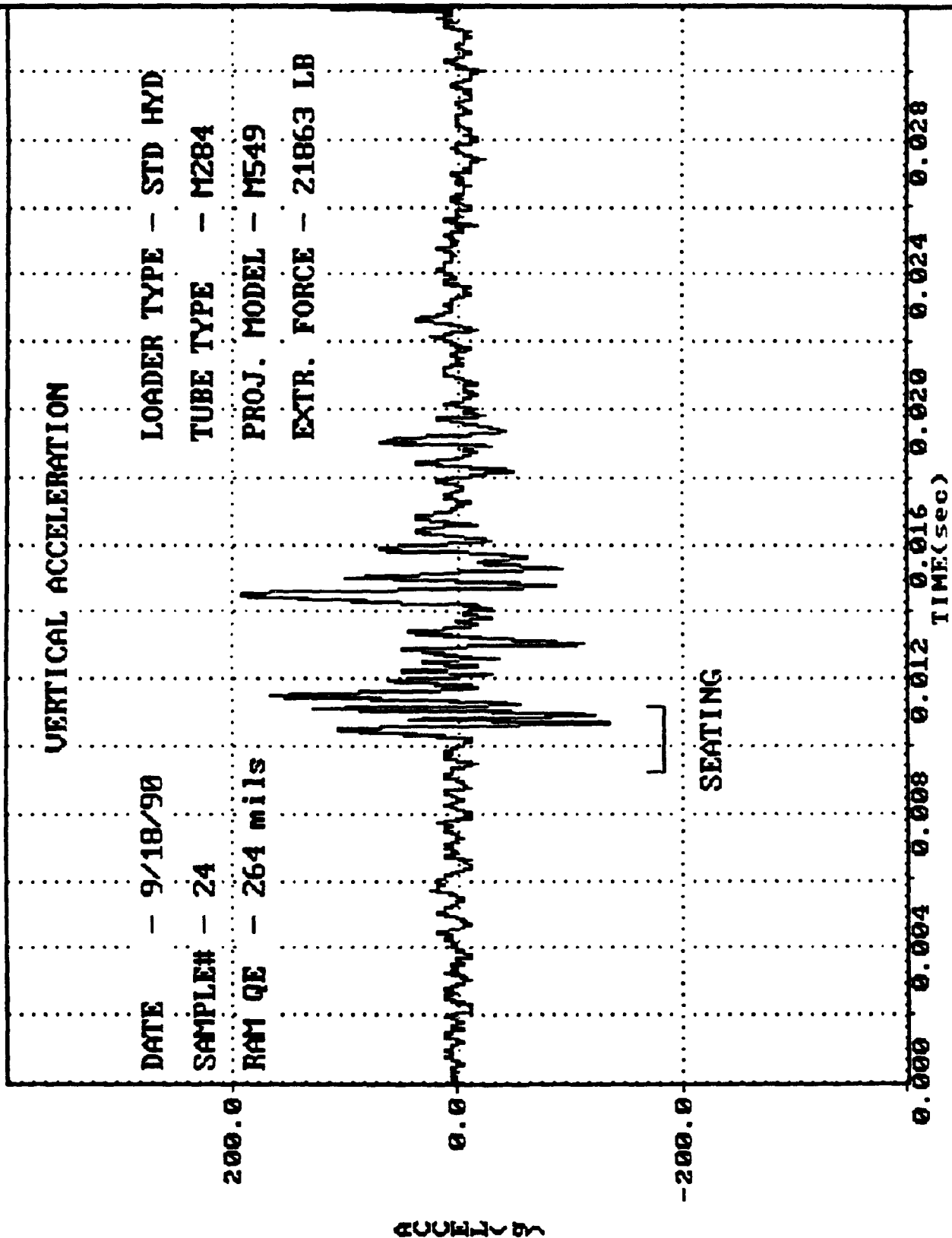
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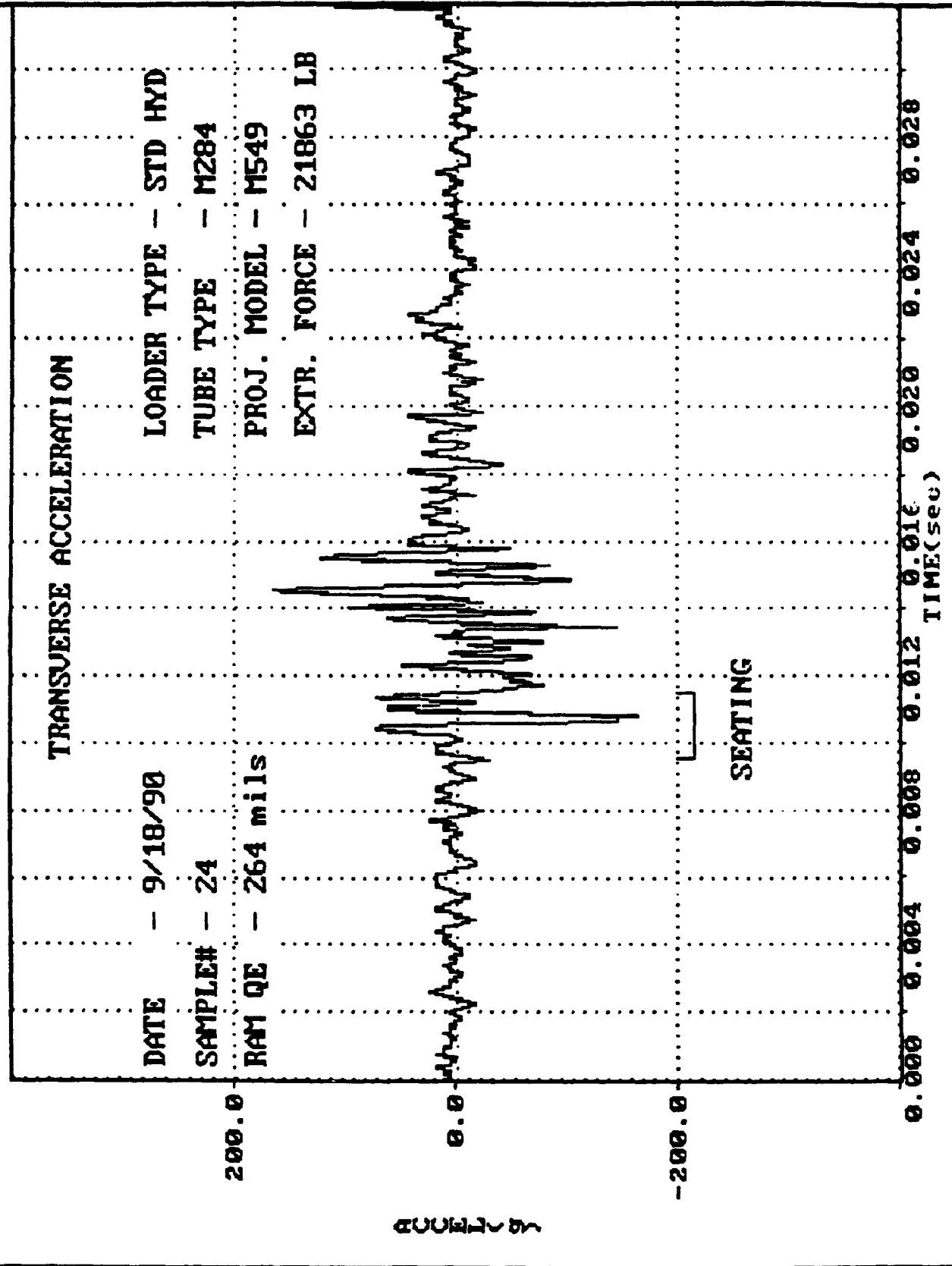
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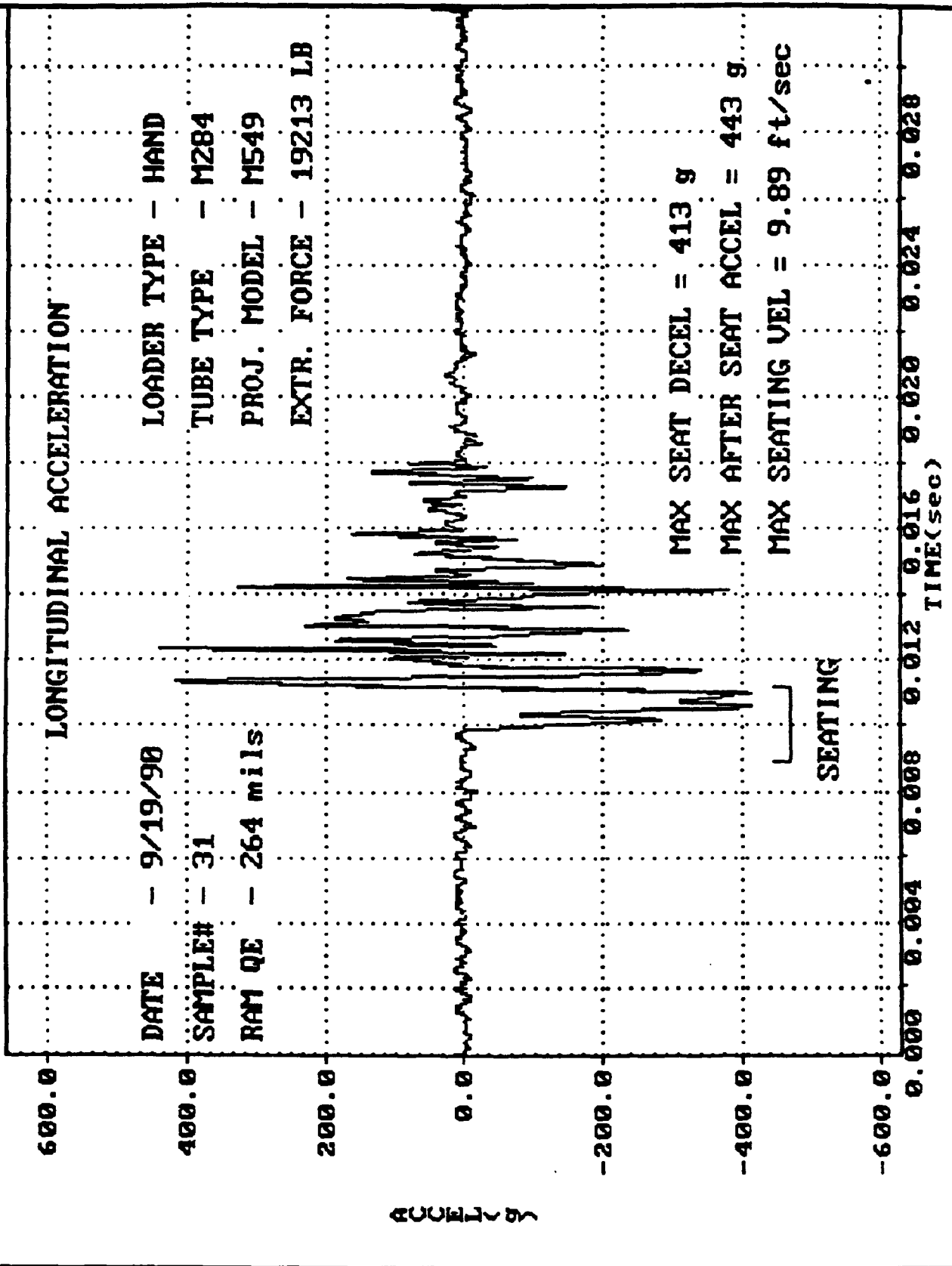
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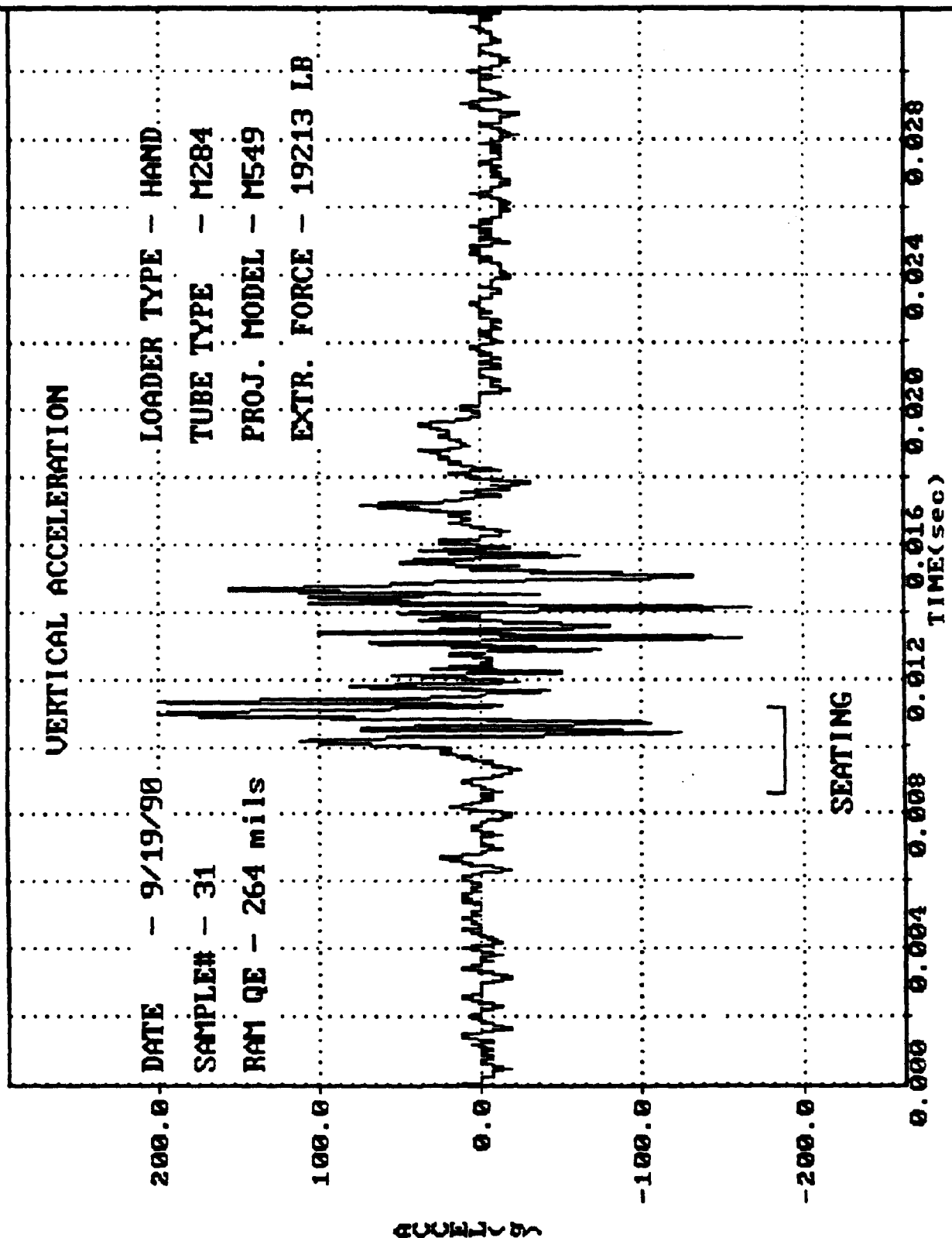
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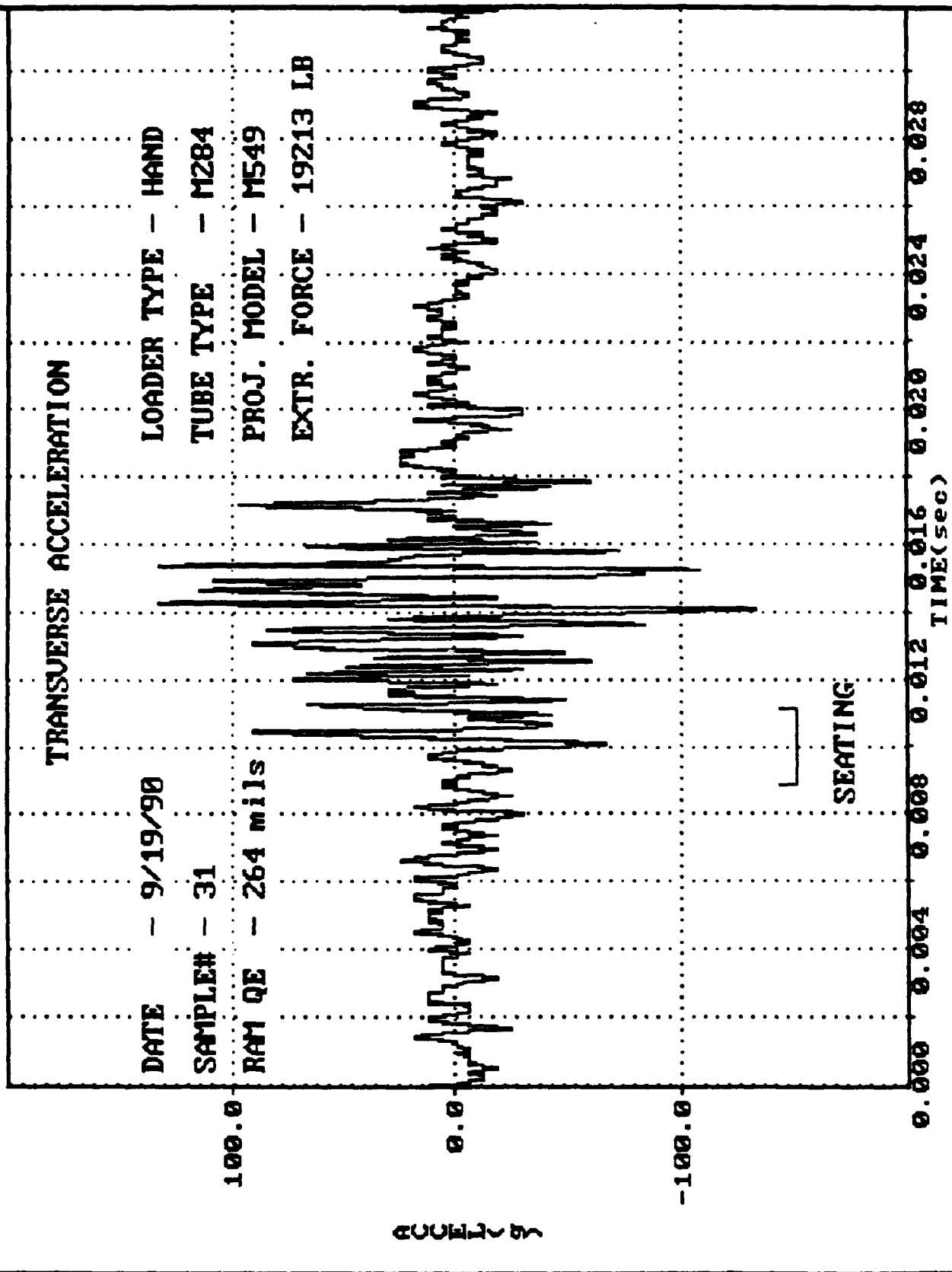


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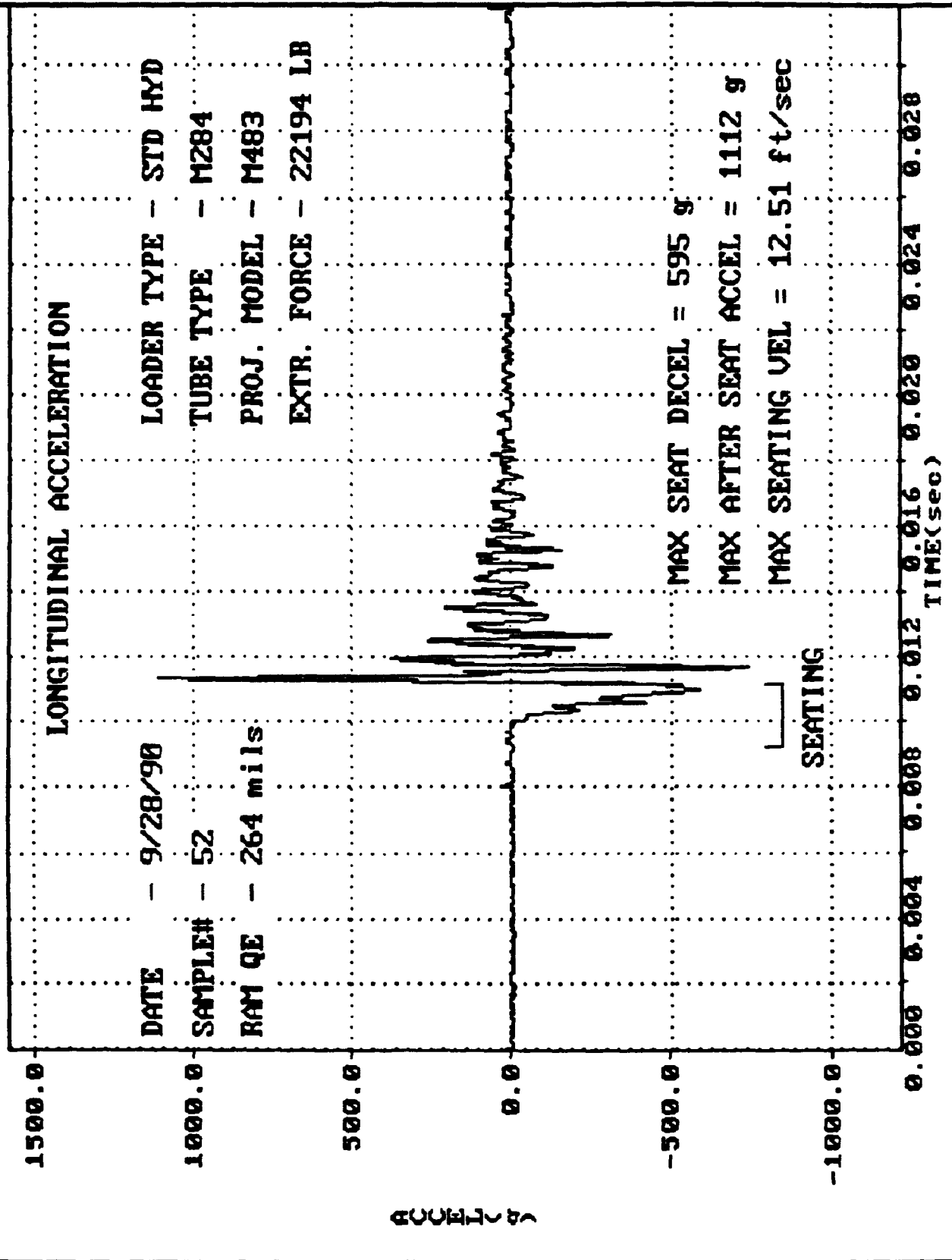




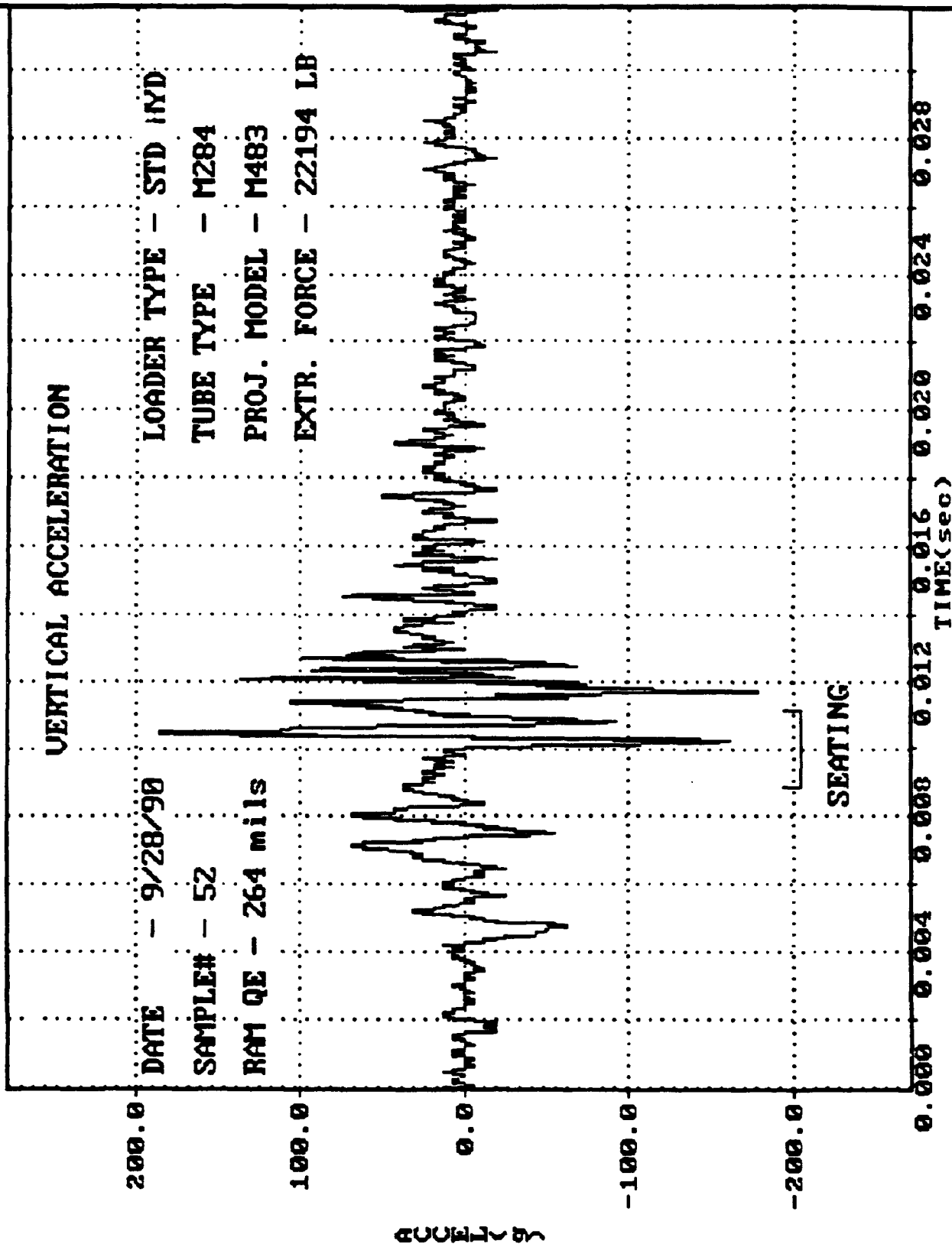
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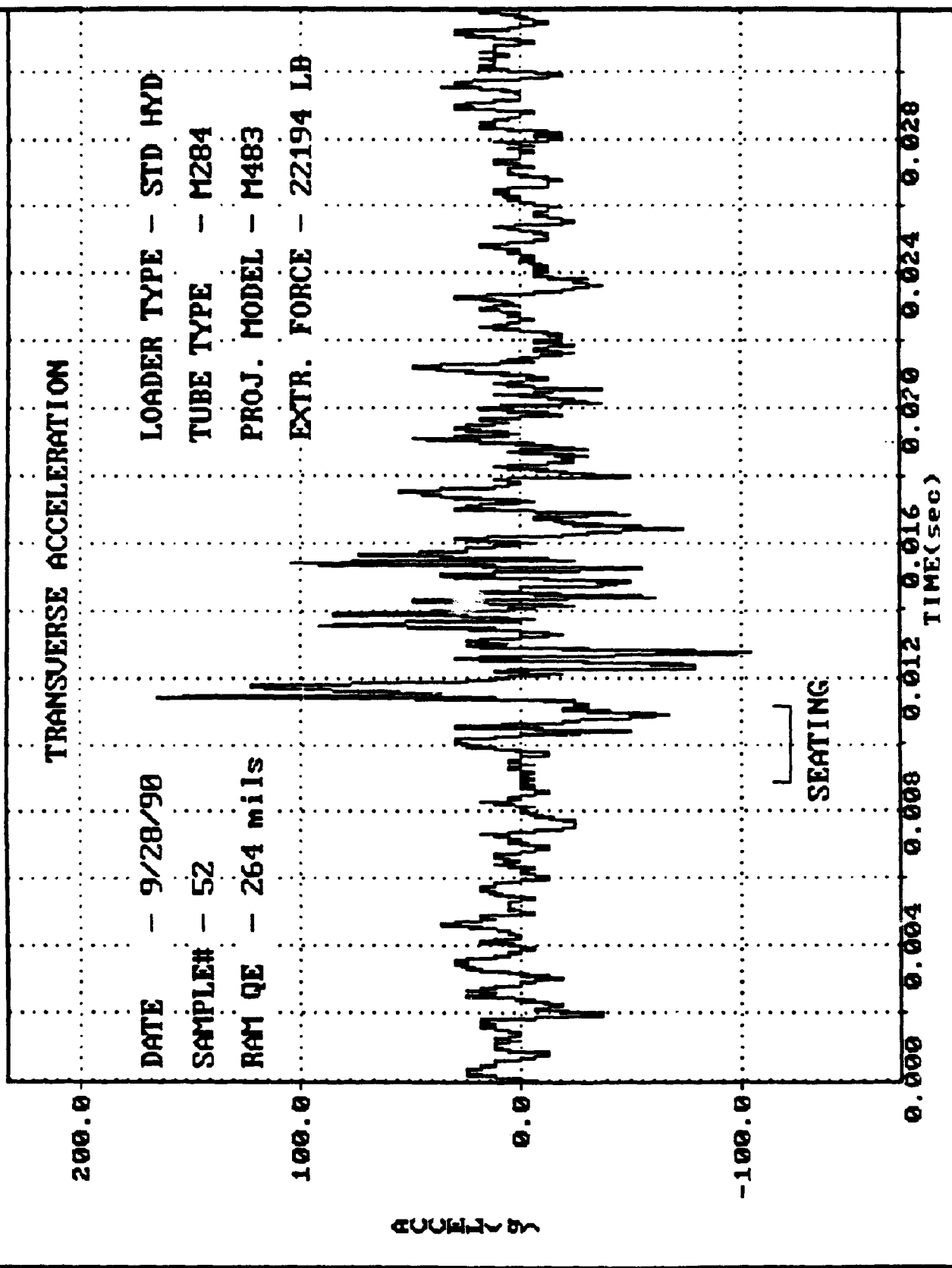
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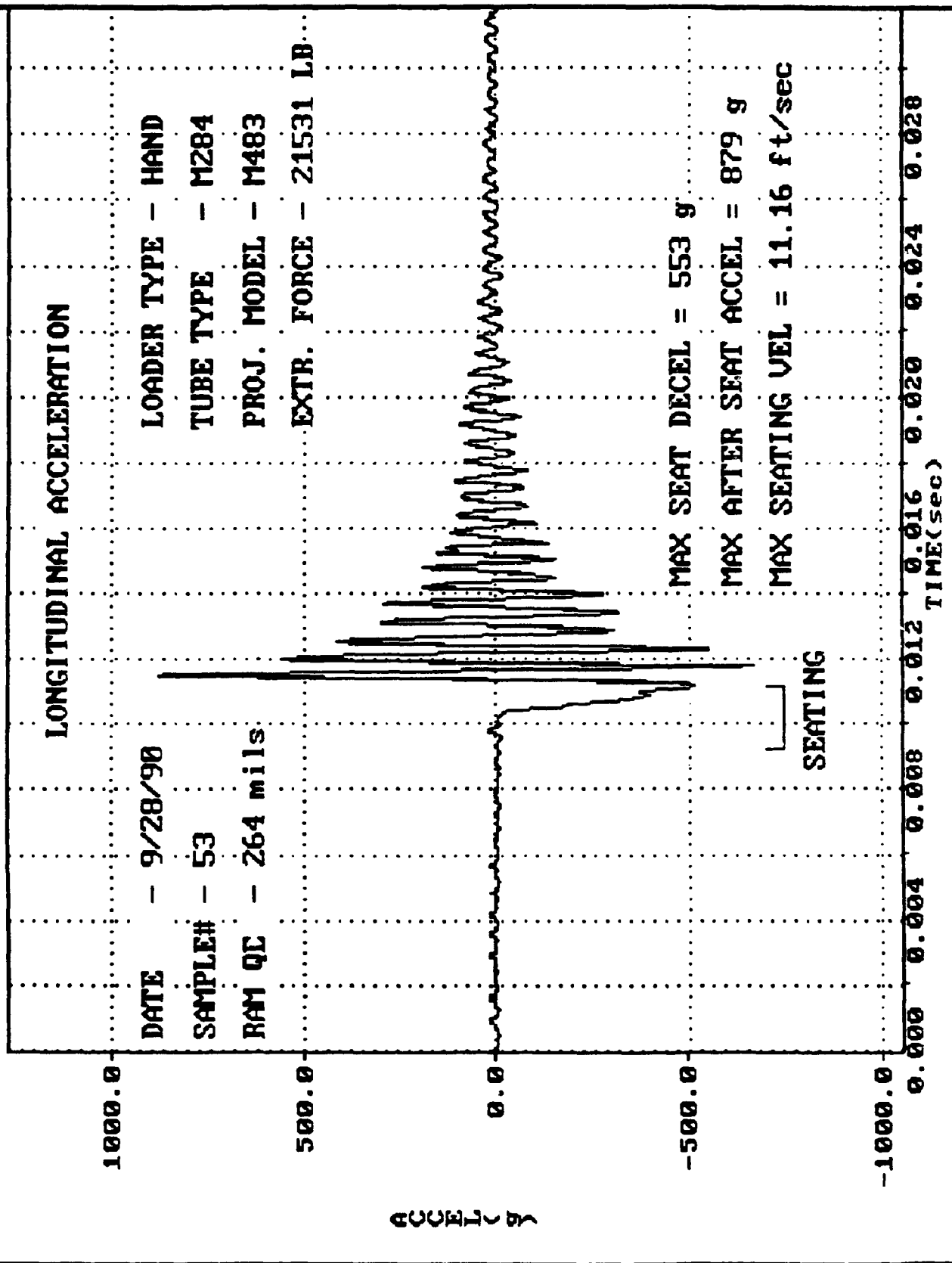
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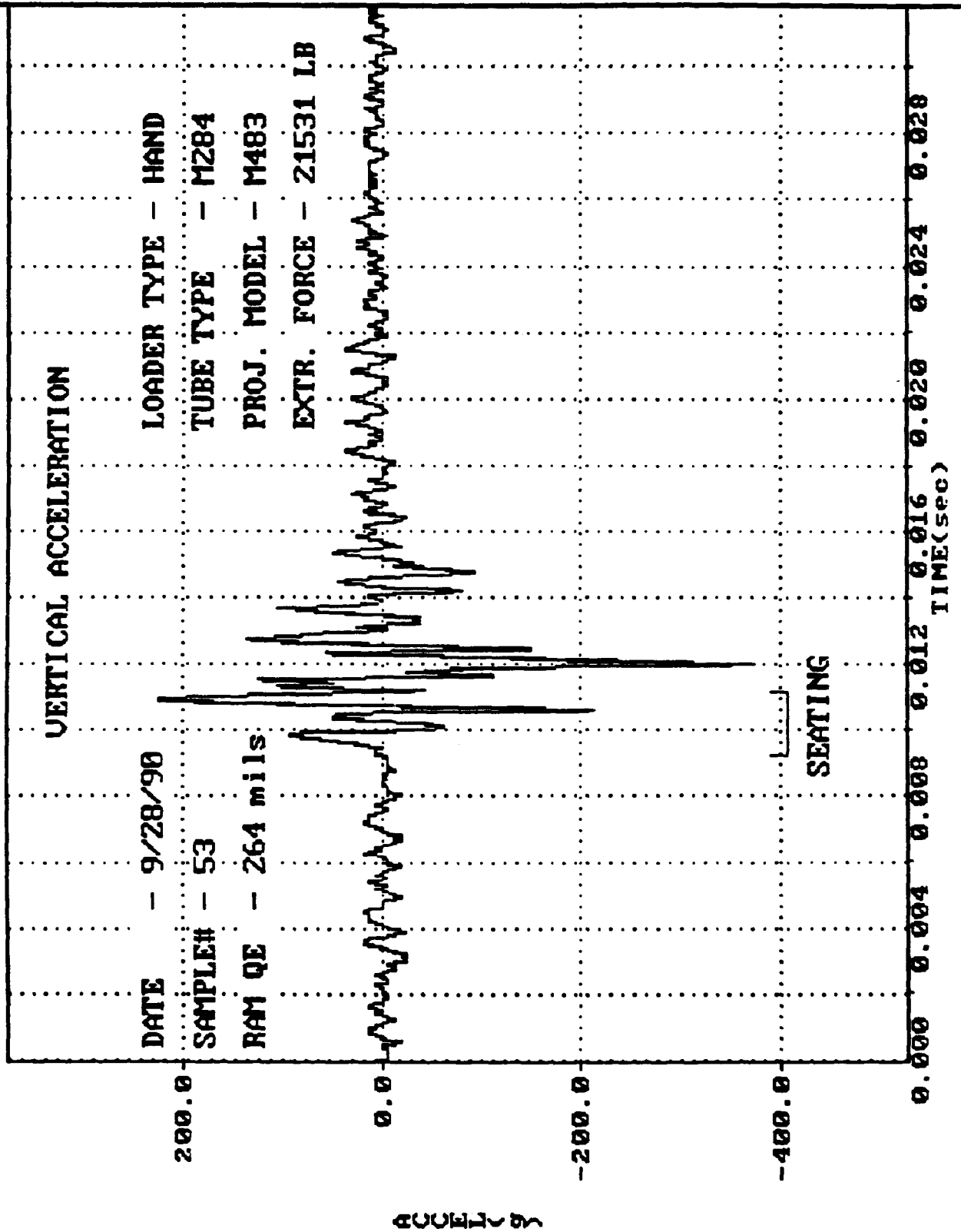
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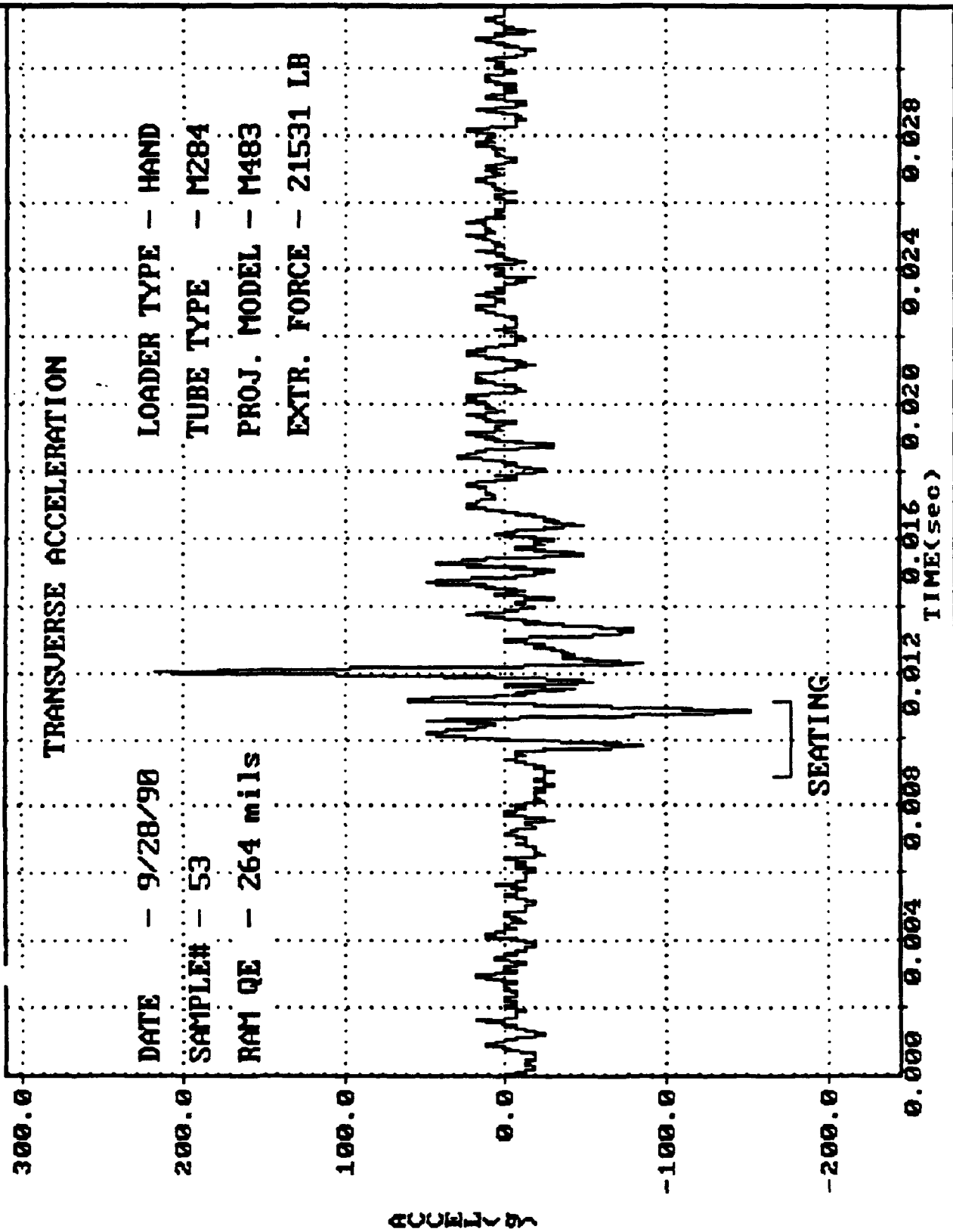
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# FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



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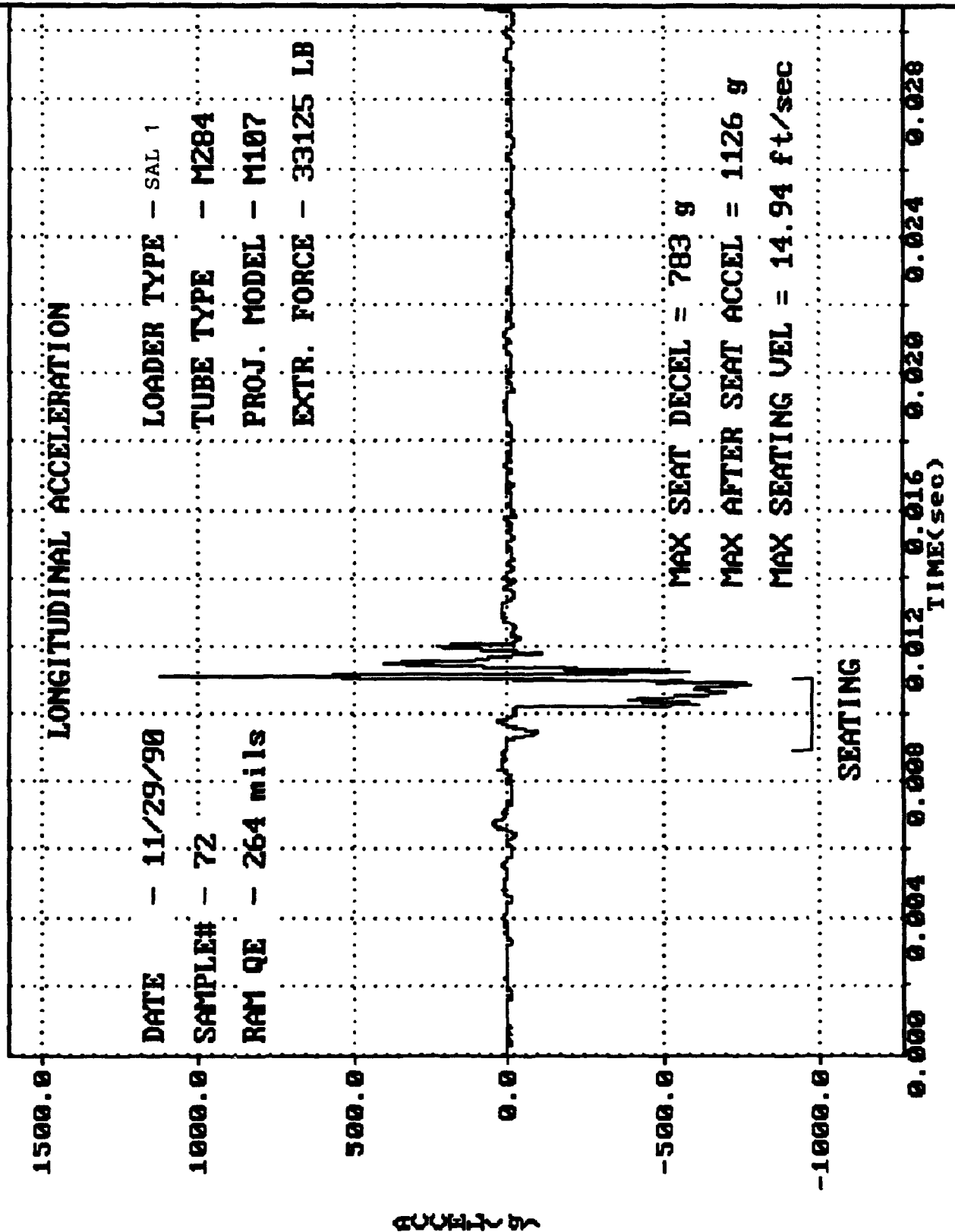


**APPENDIX B**

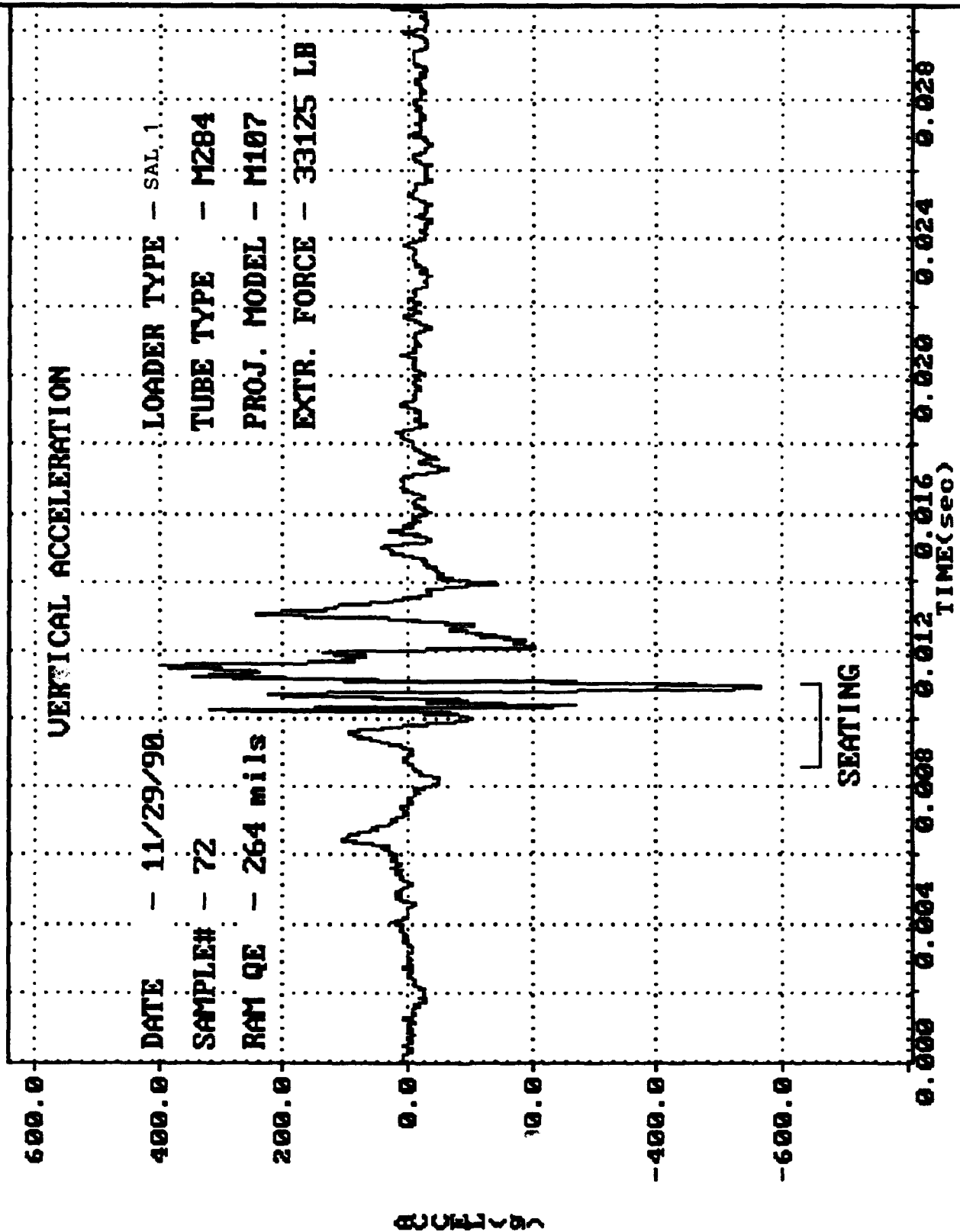
**WF RAMS**



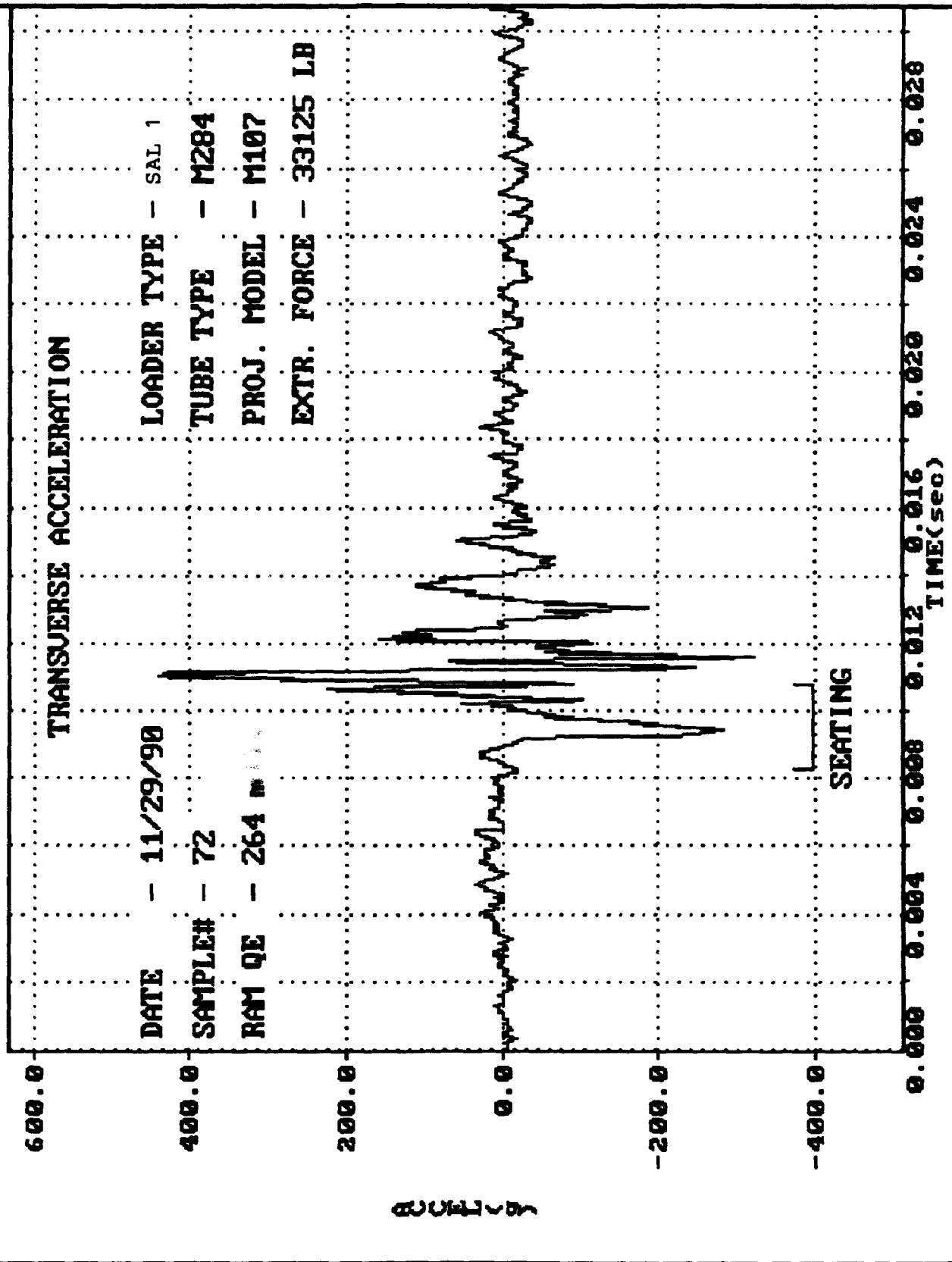
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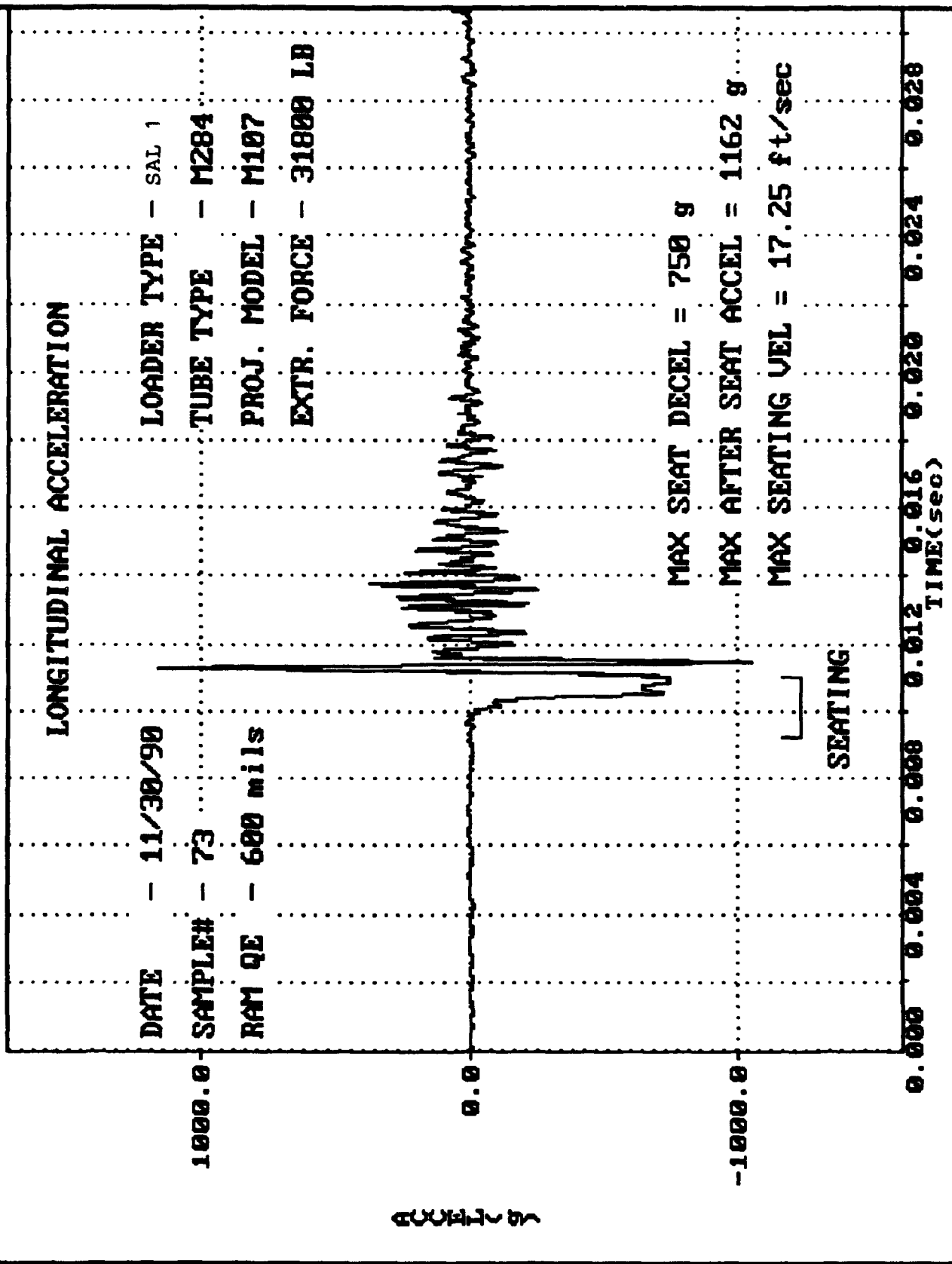
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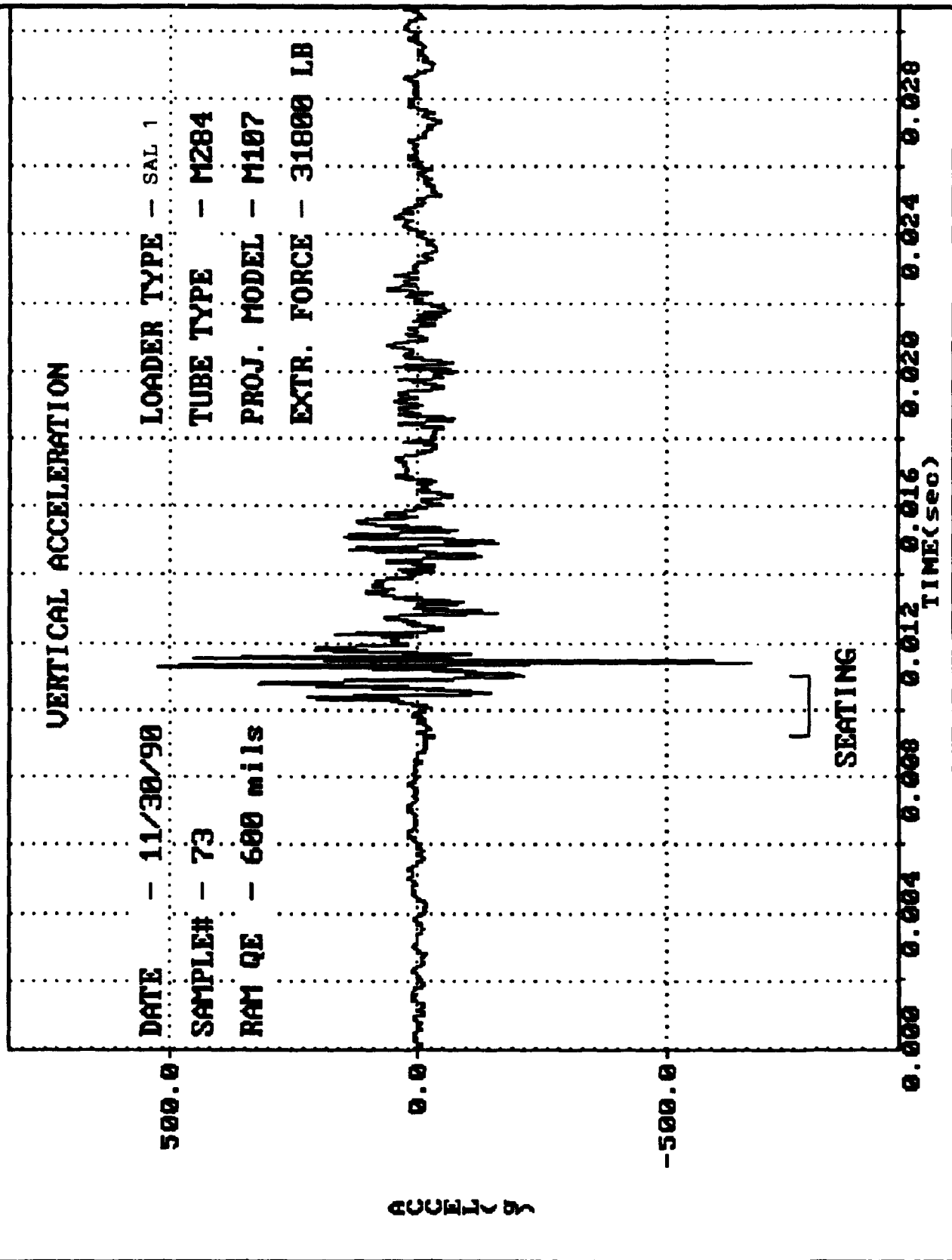
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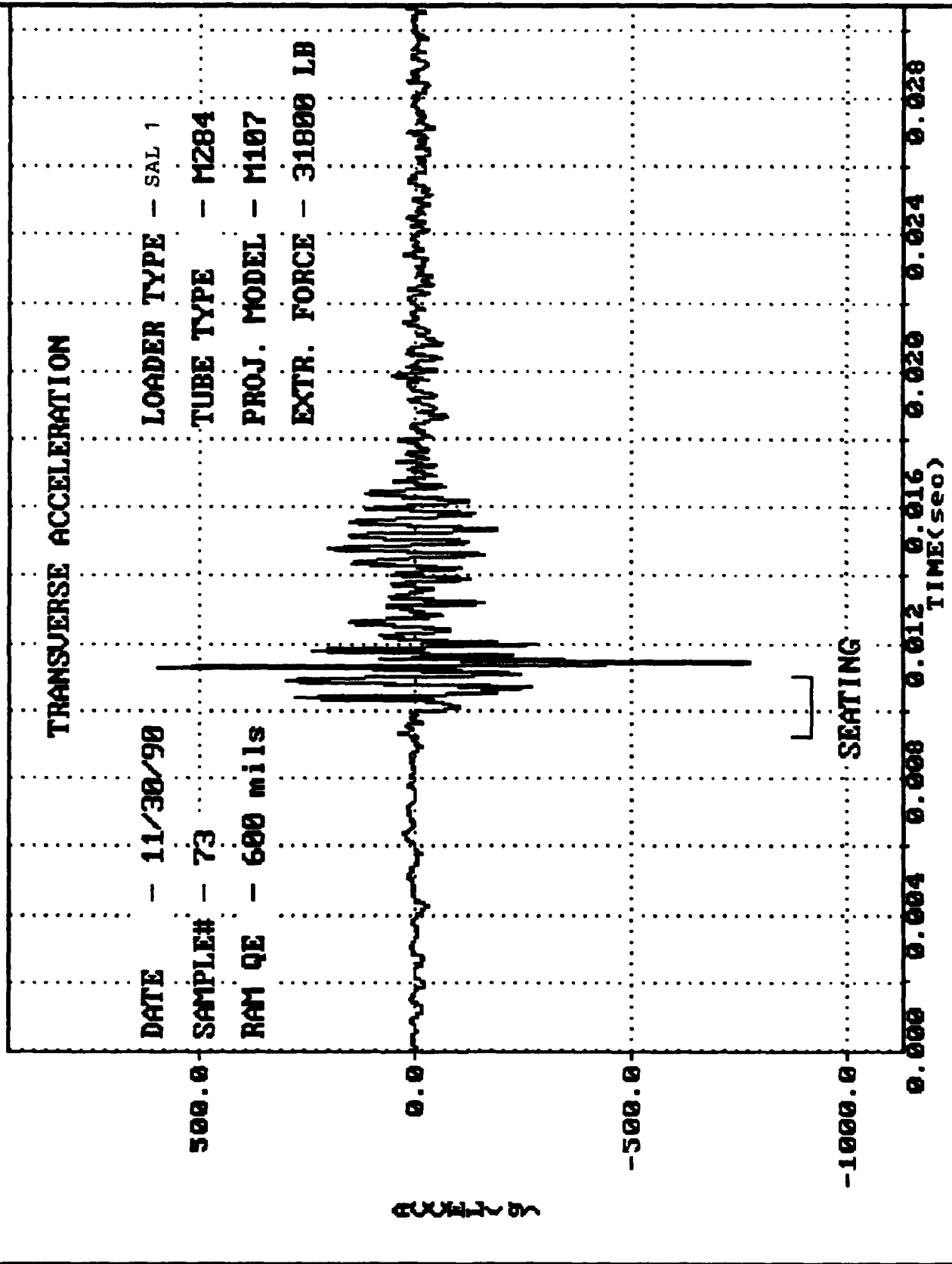
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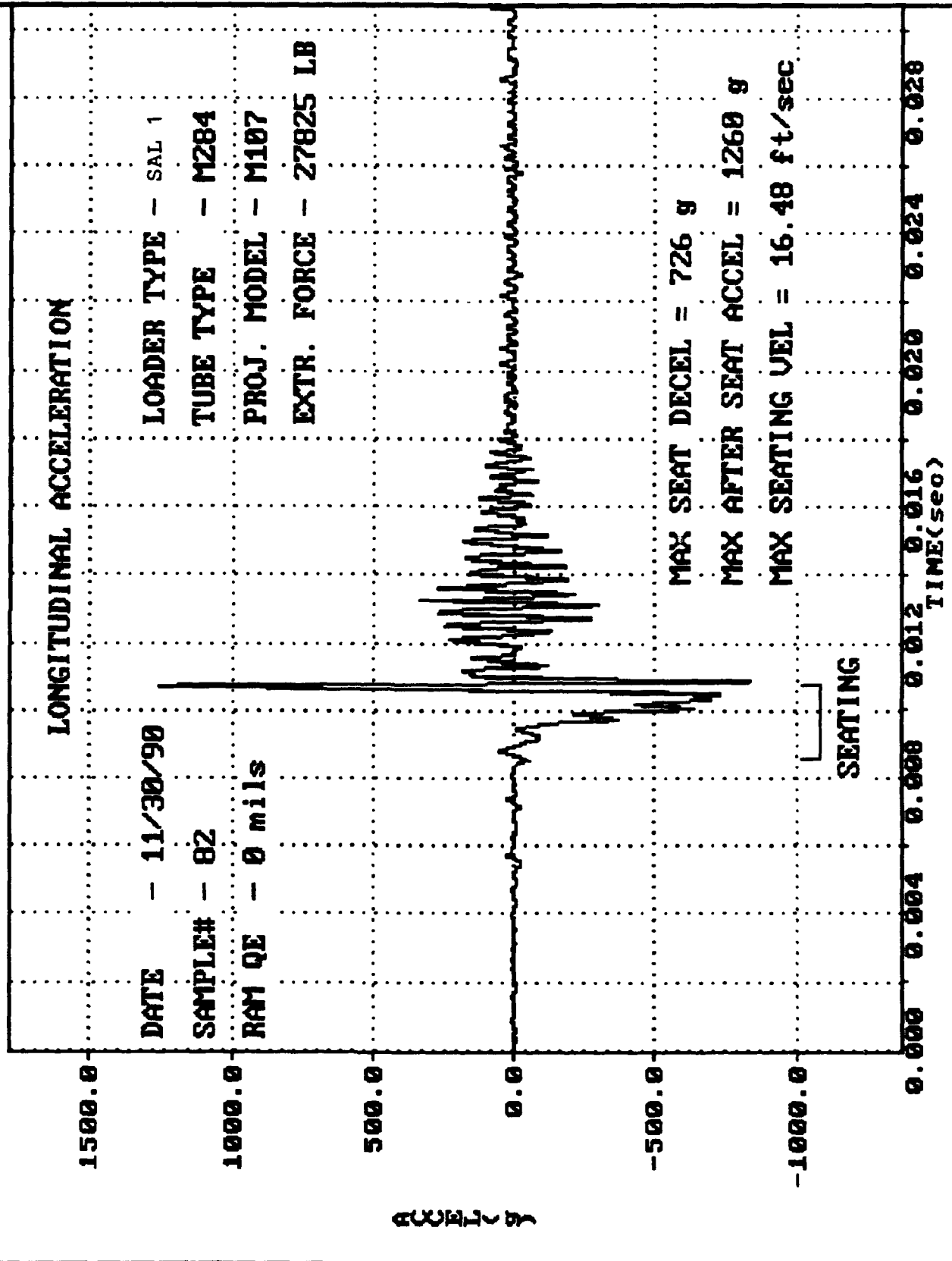
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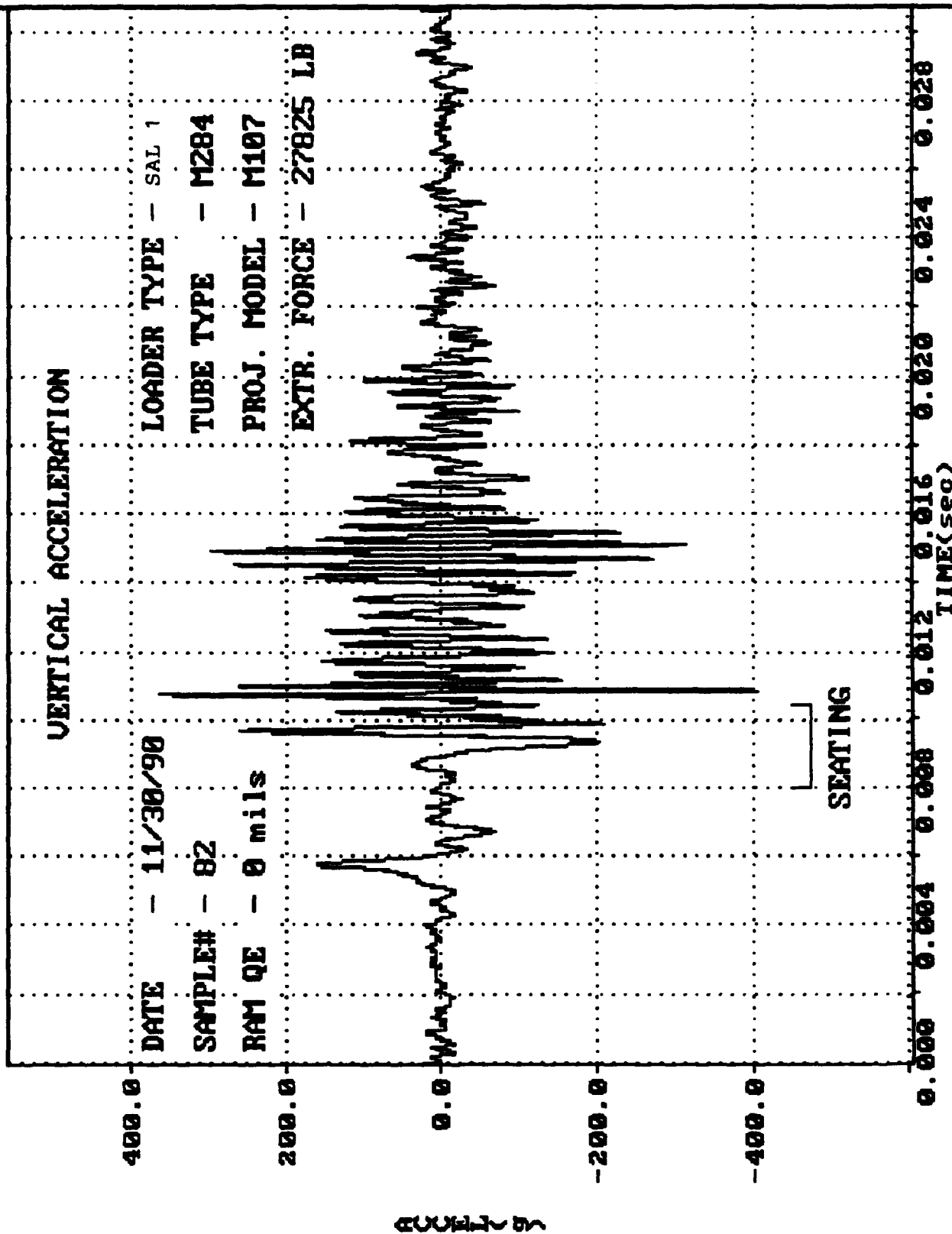
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# FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS

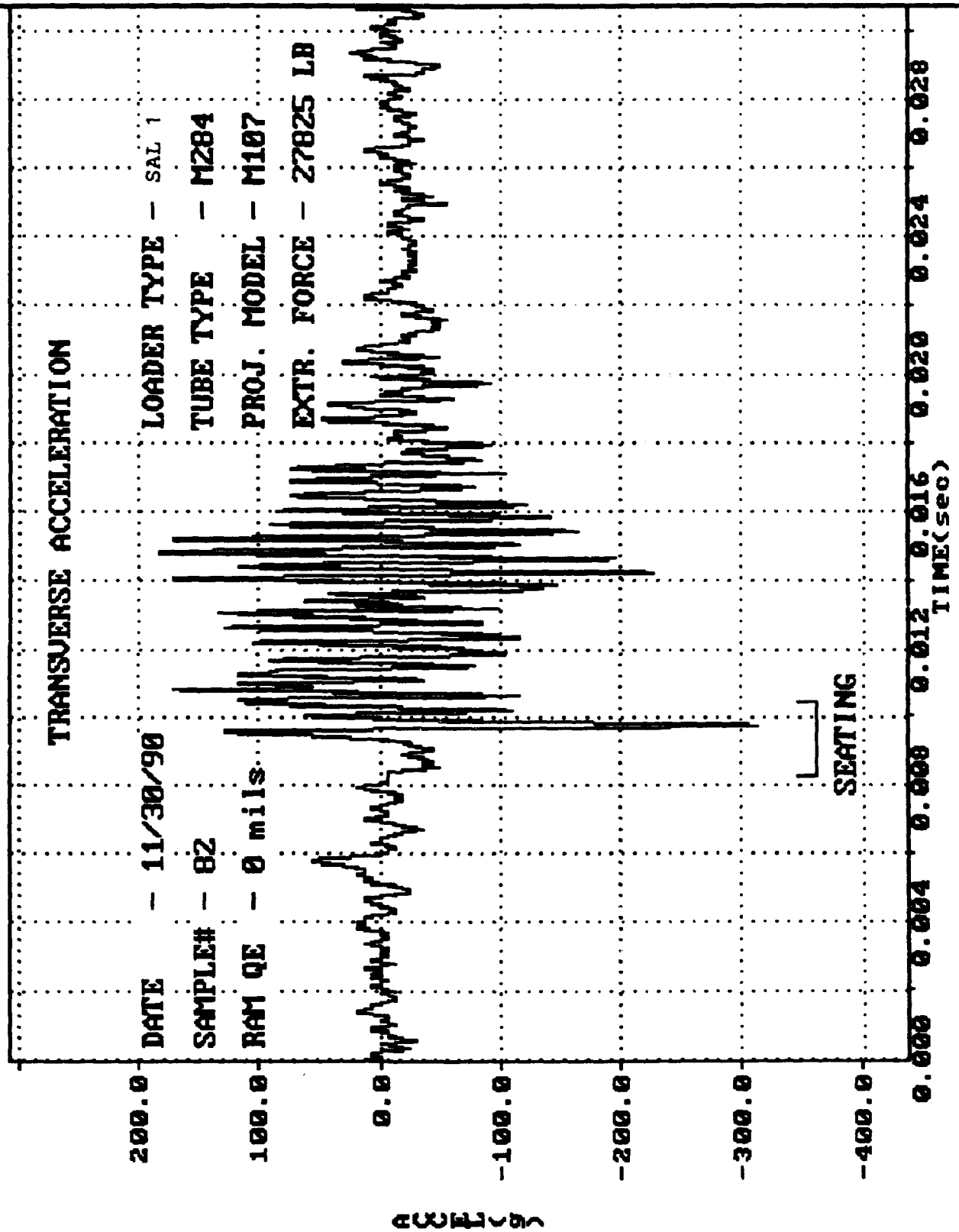


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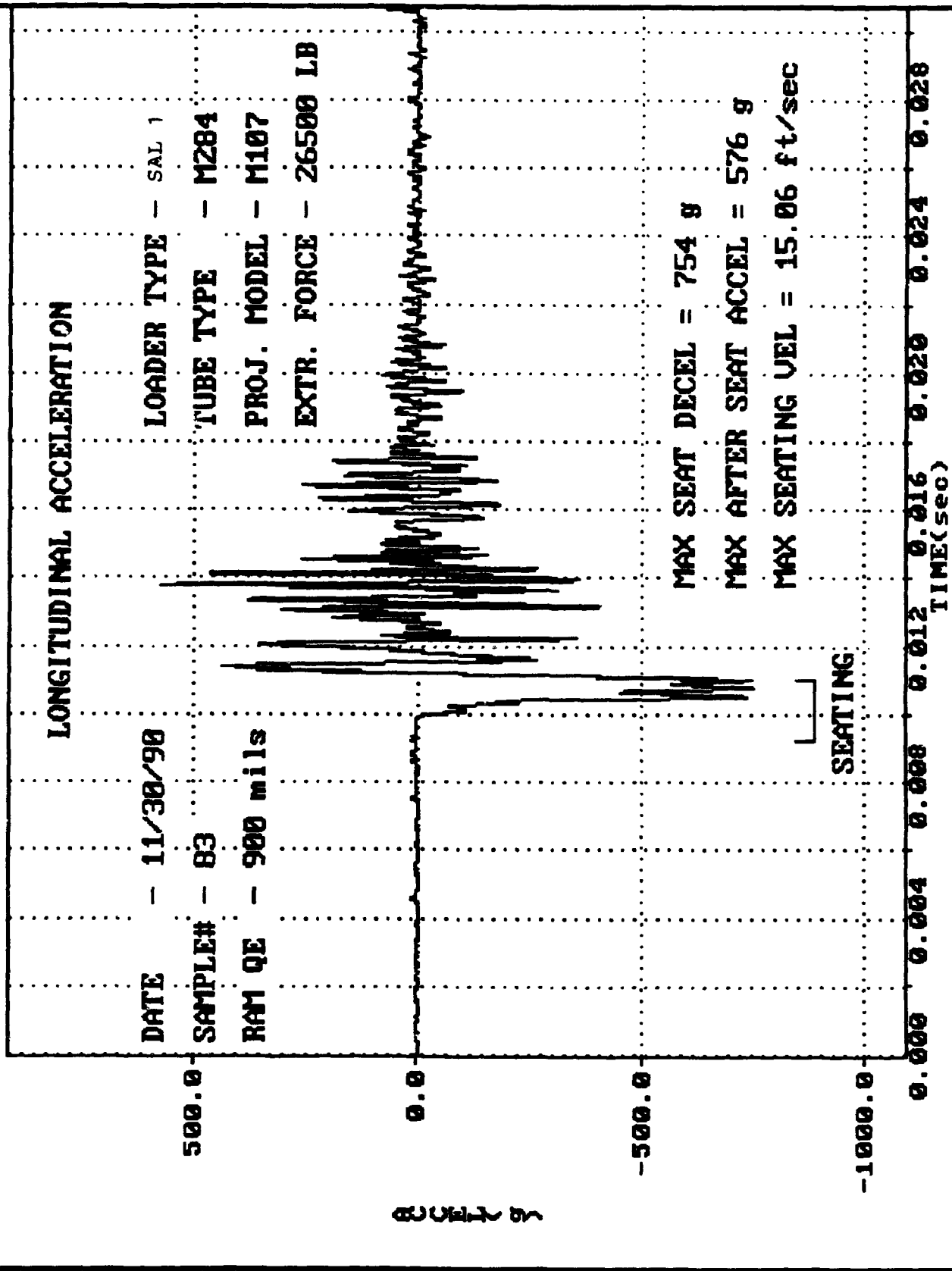




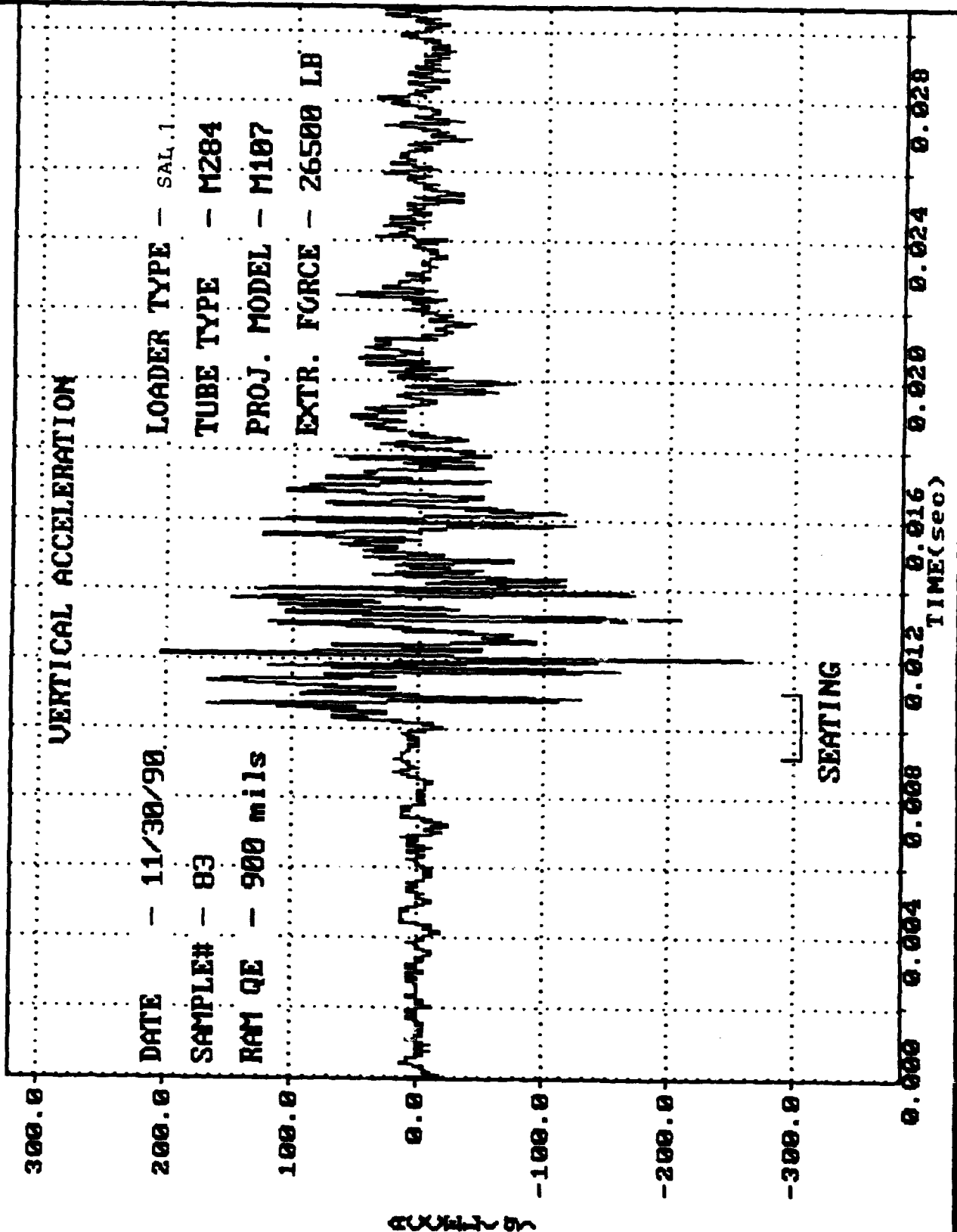
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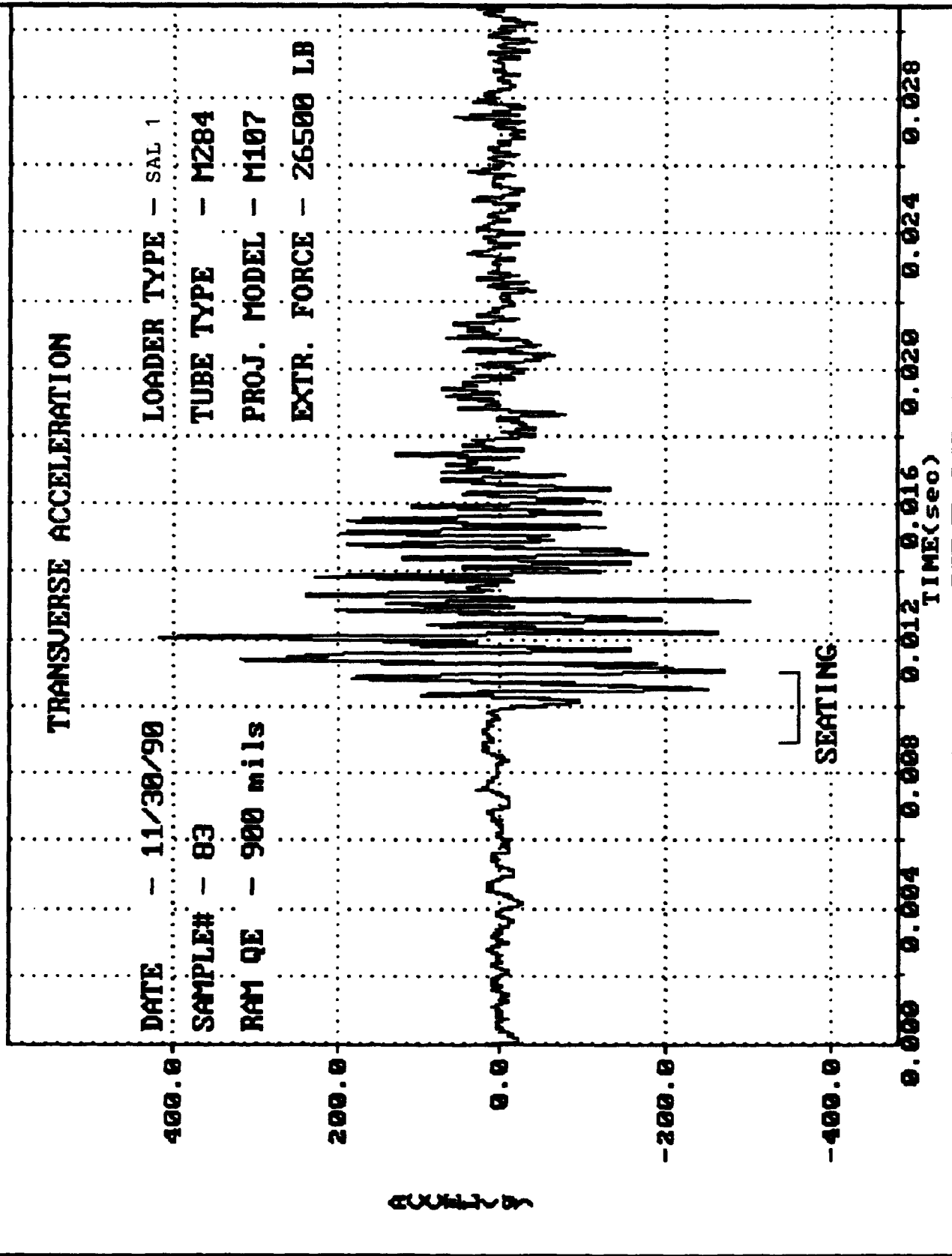
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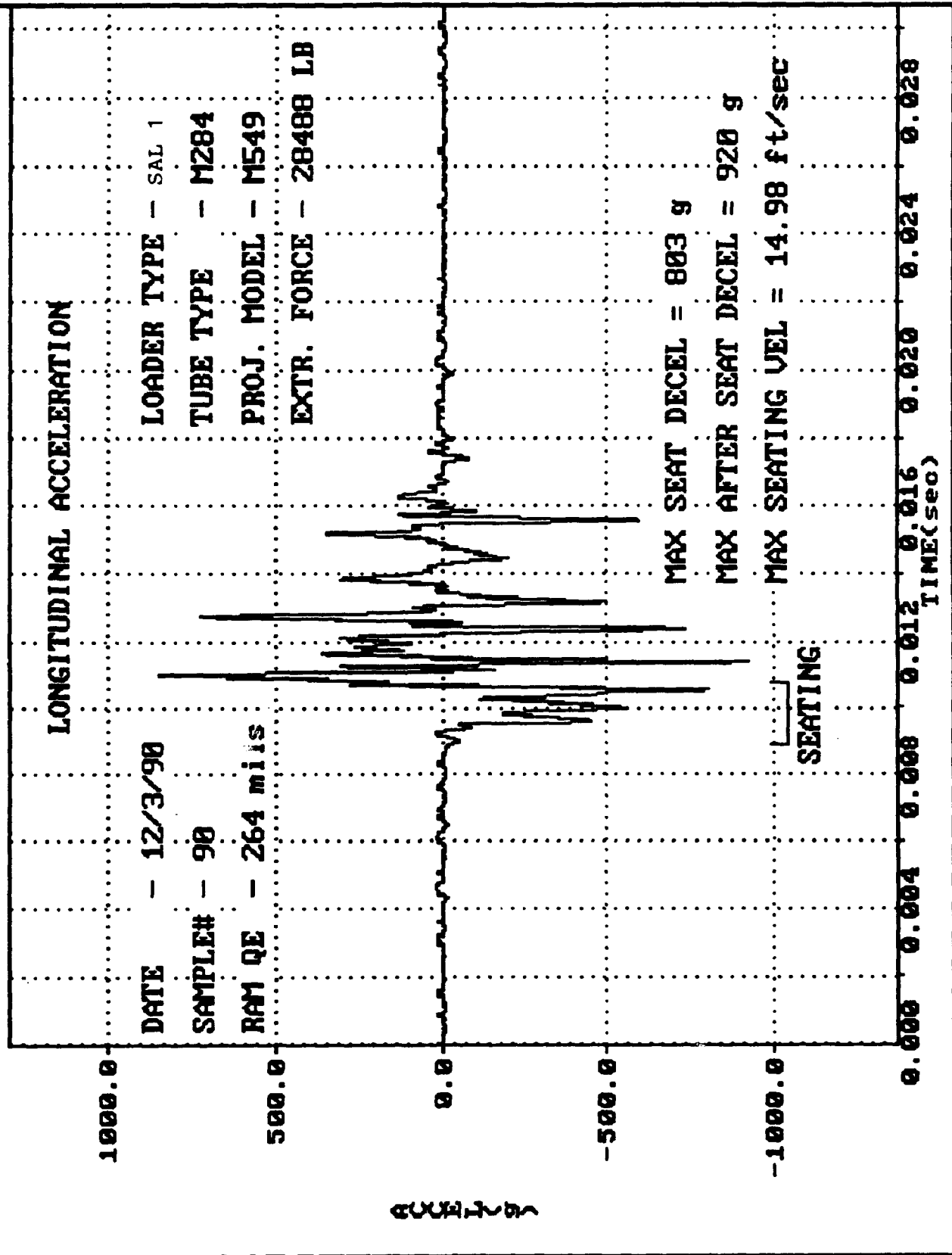
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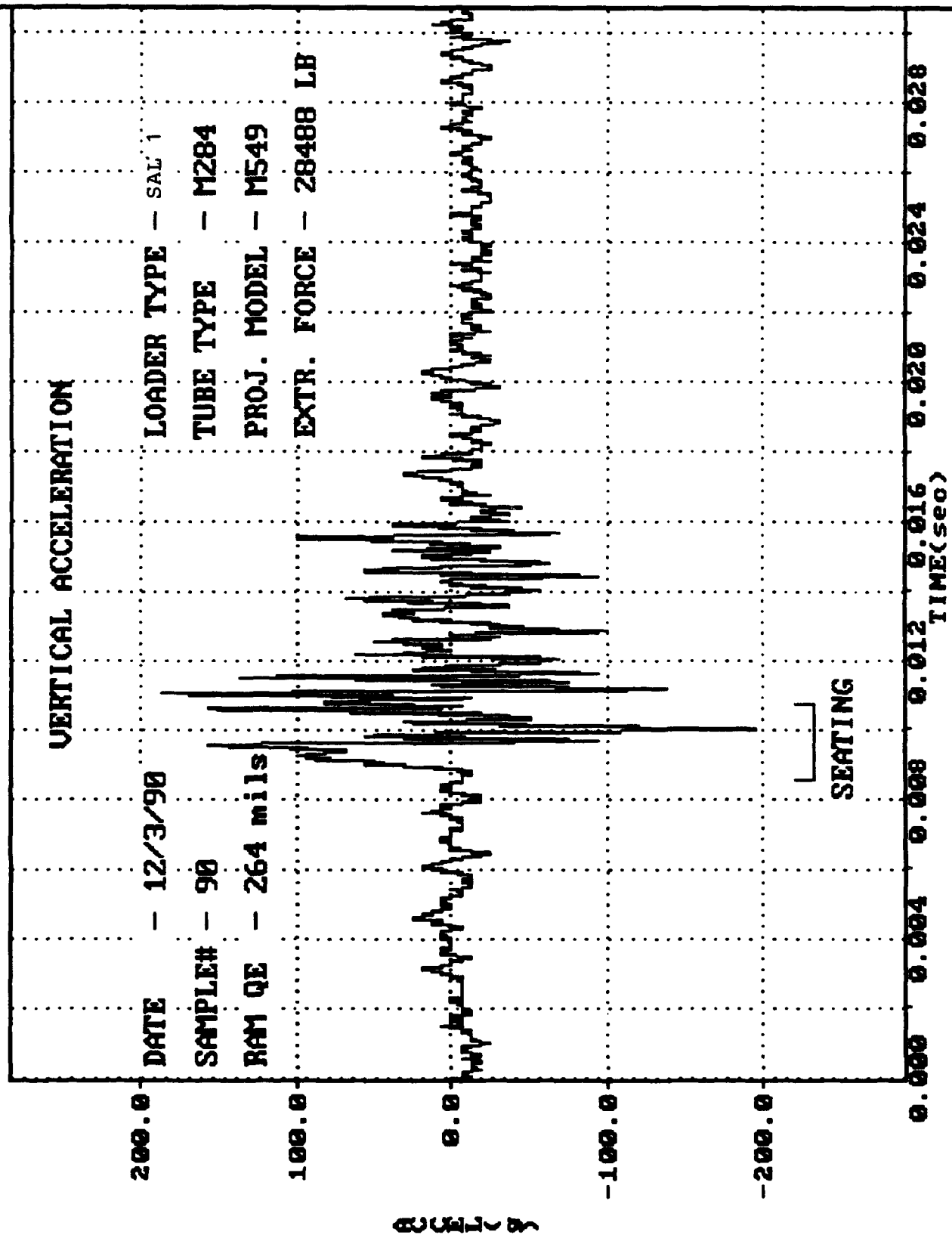
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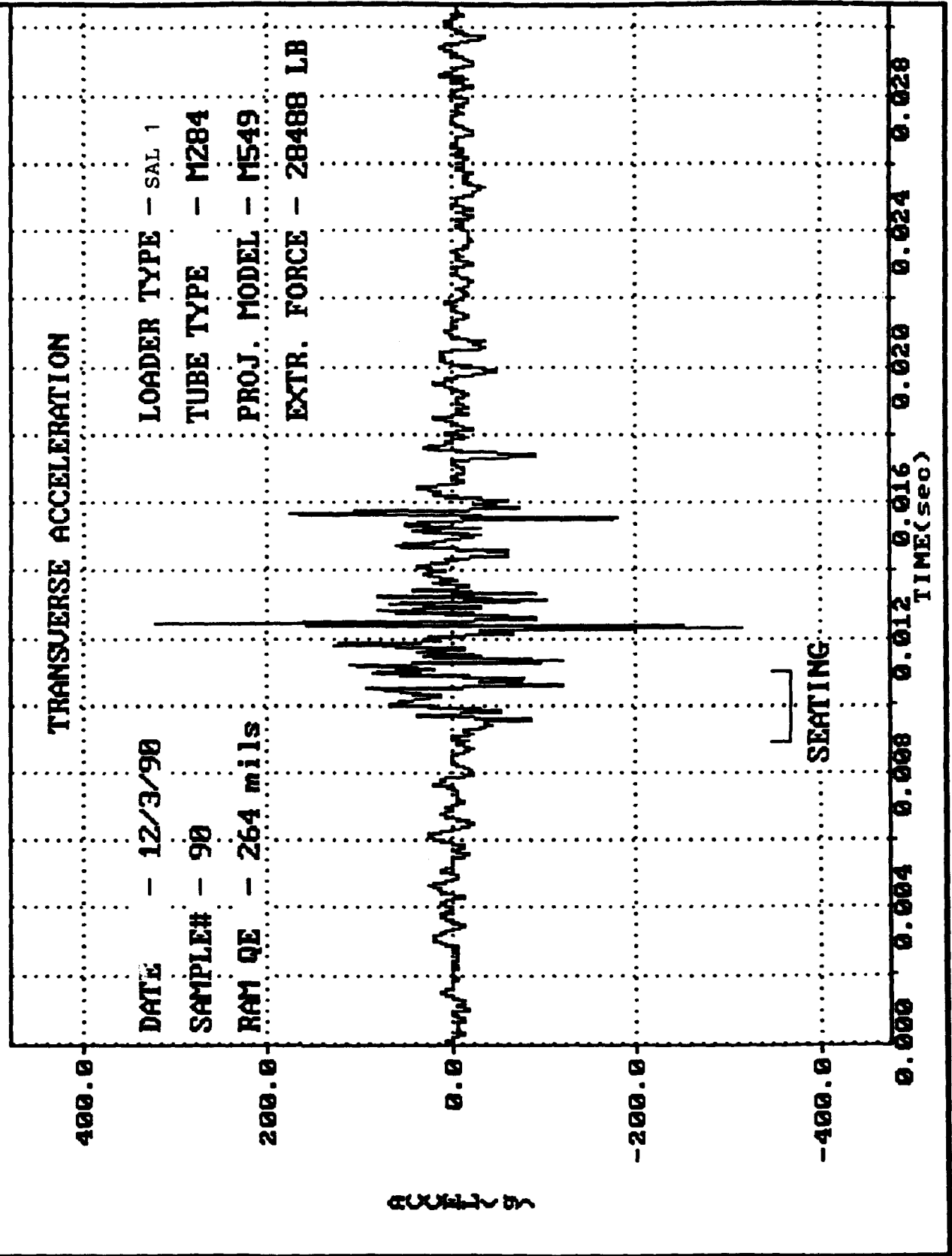
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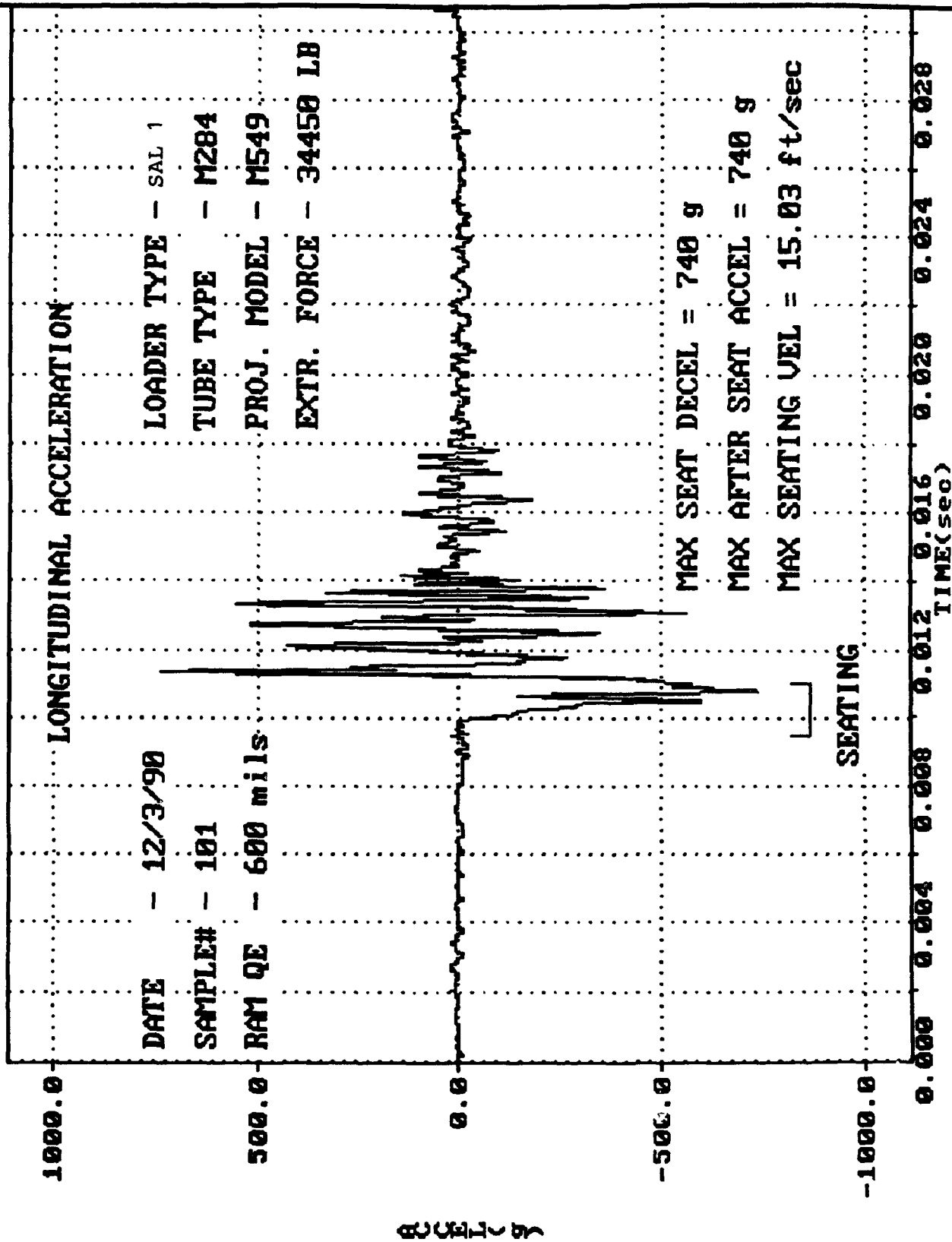
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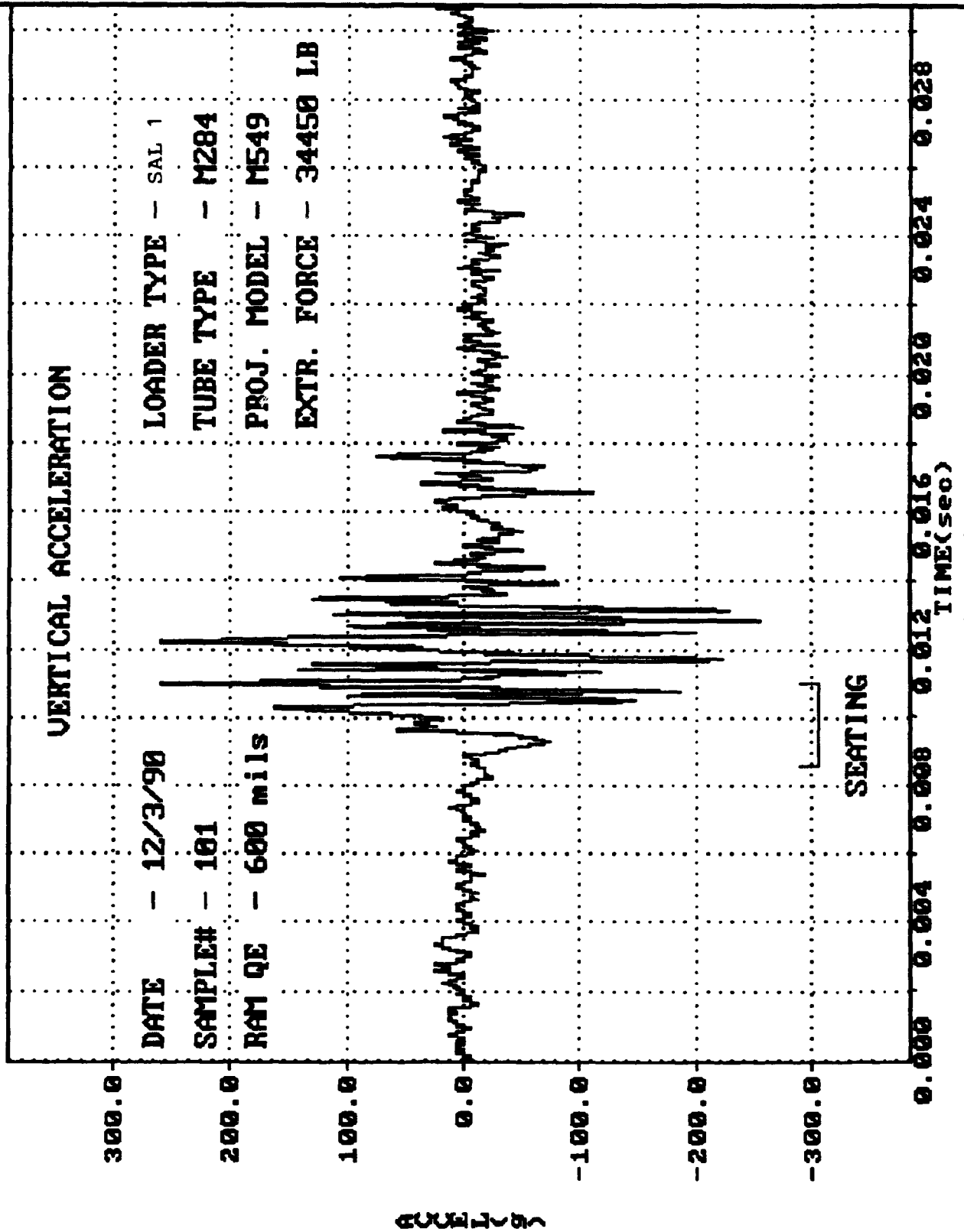


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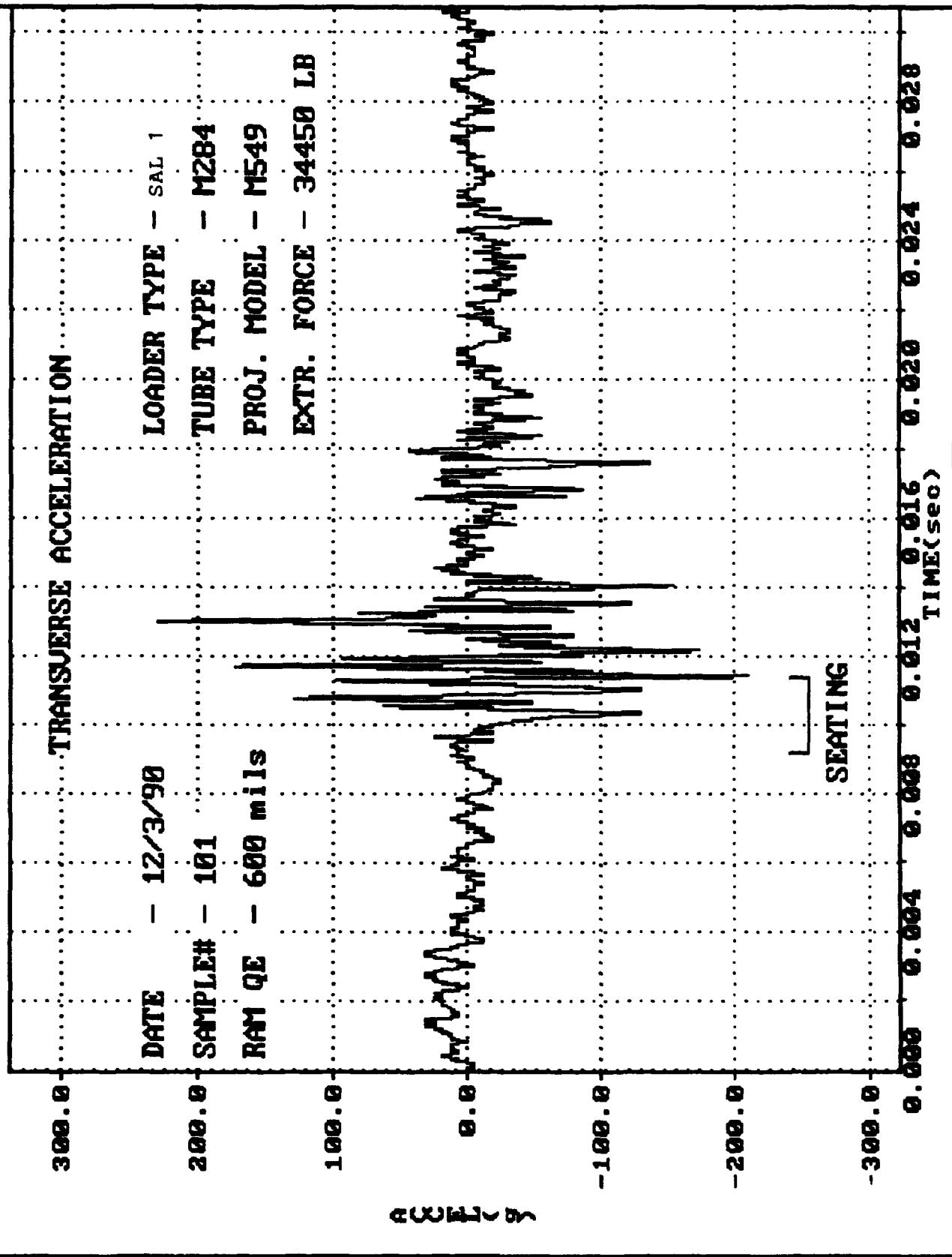




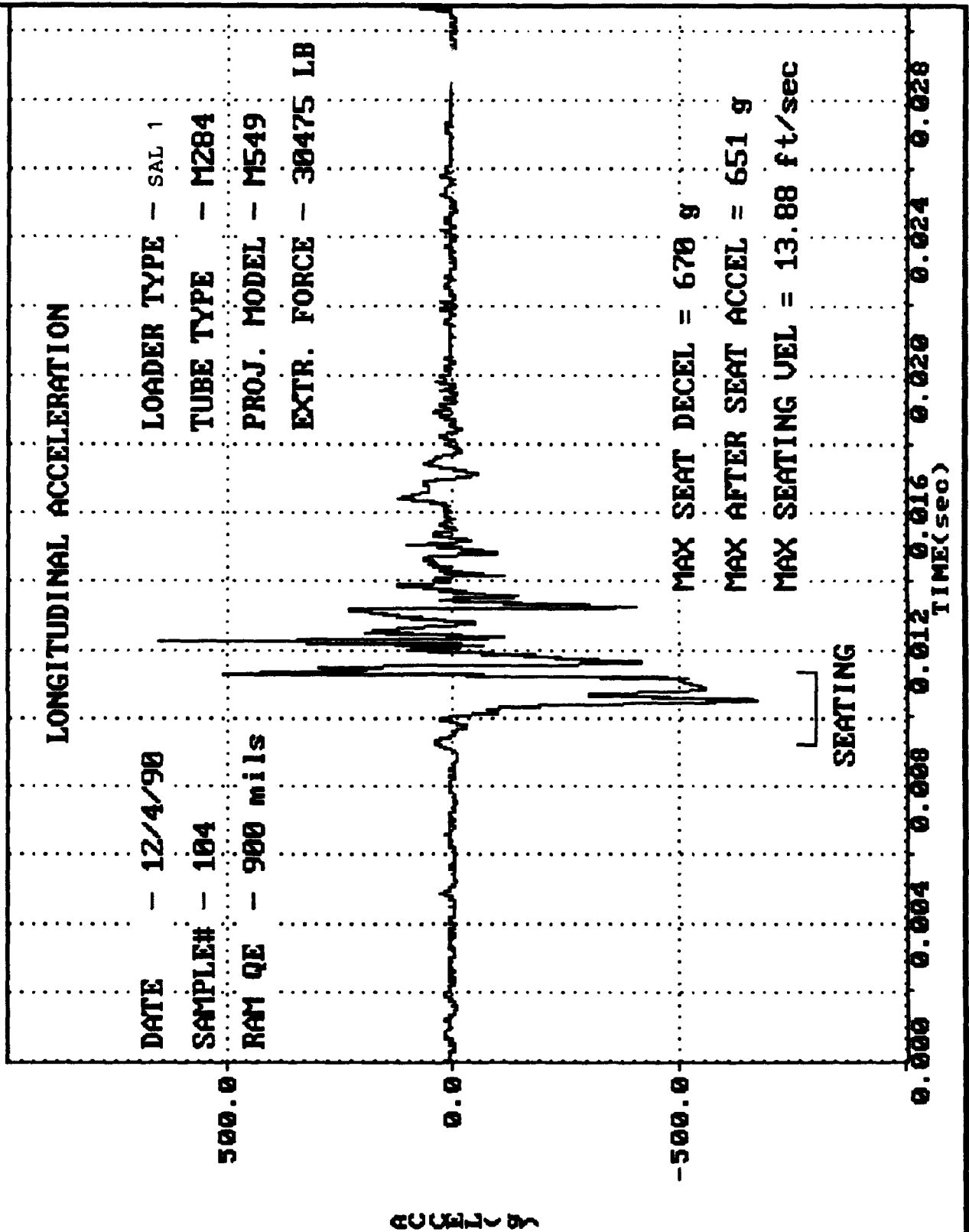
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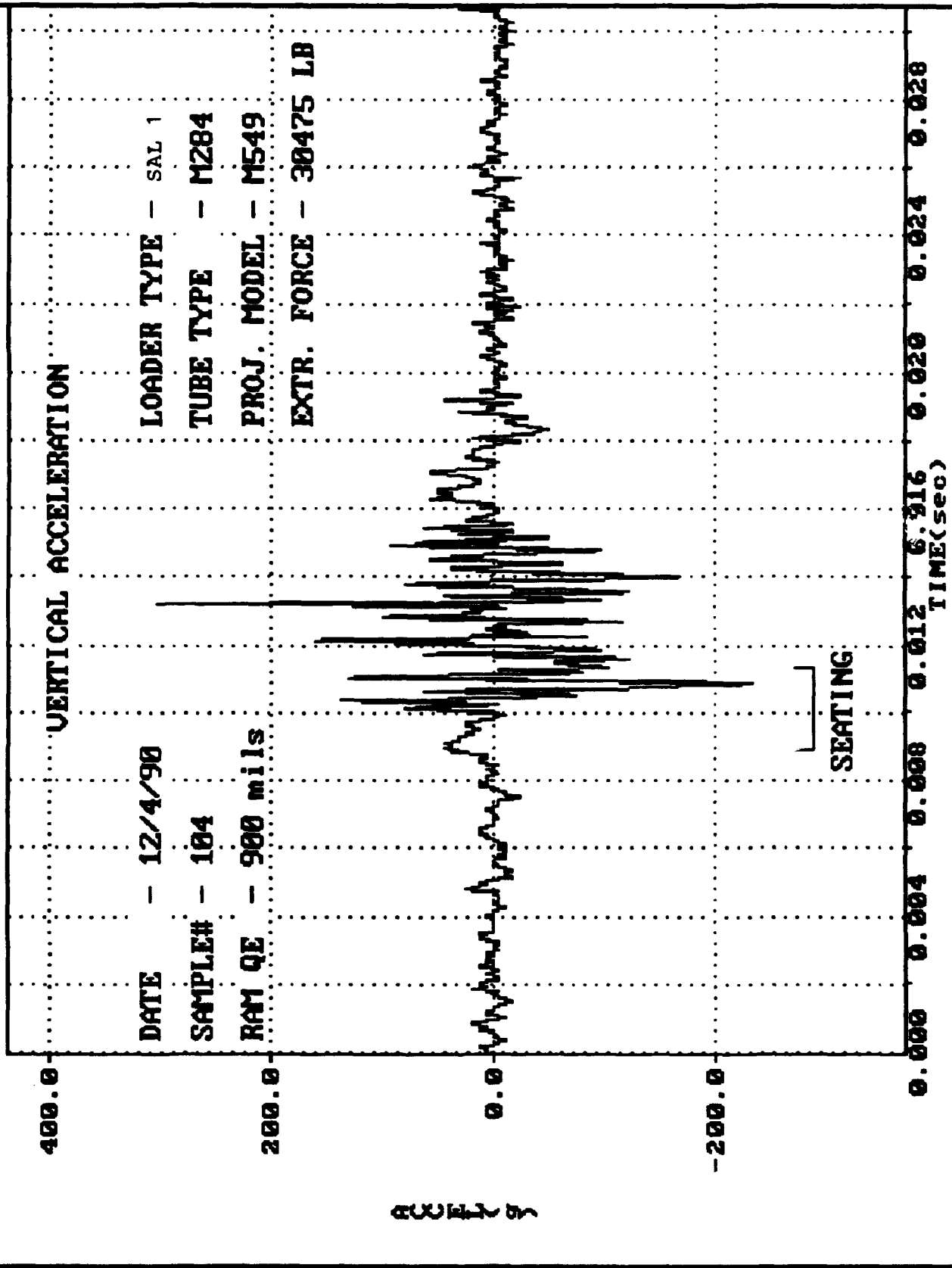
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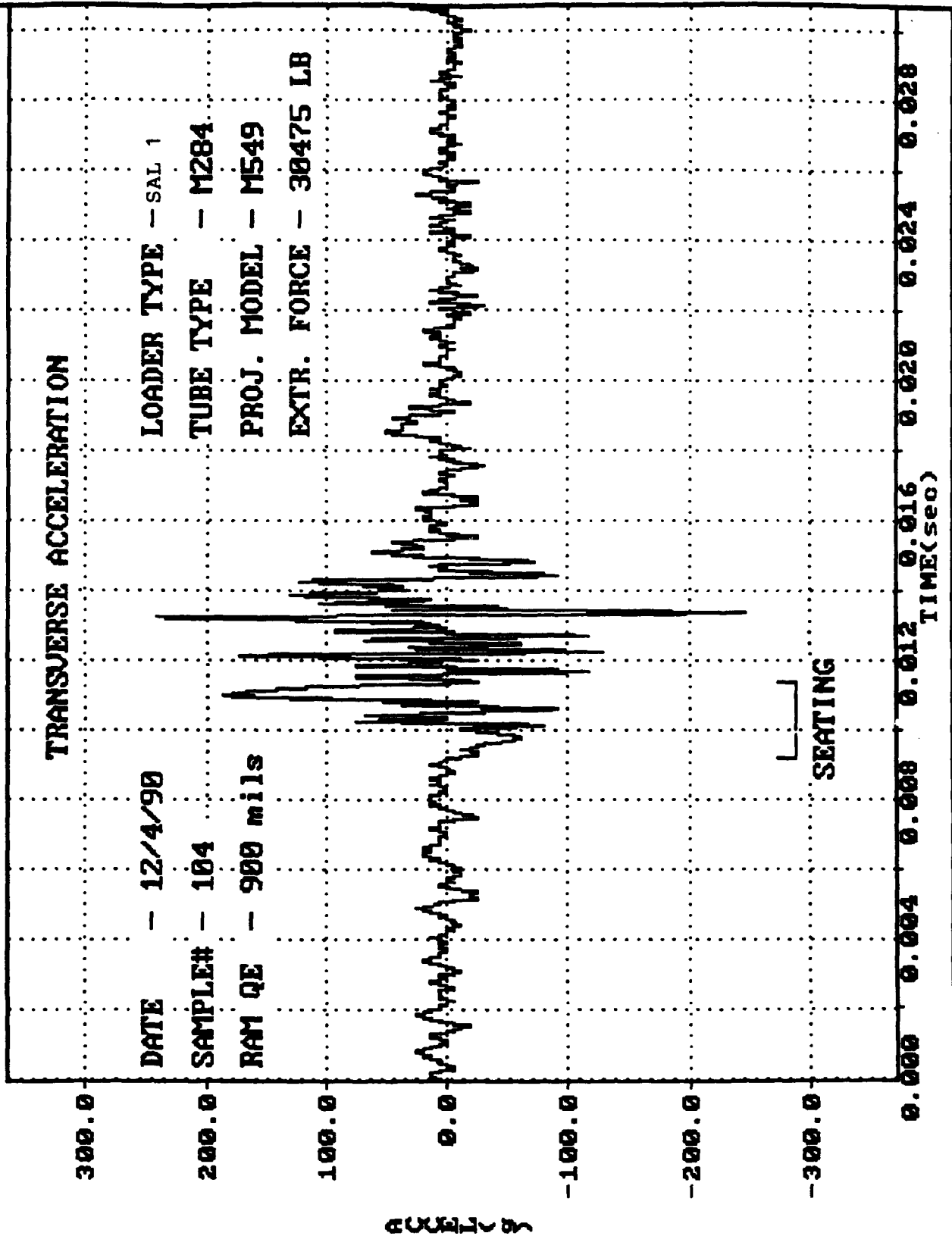
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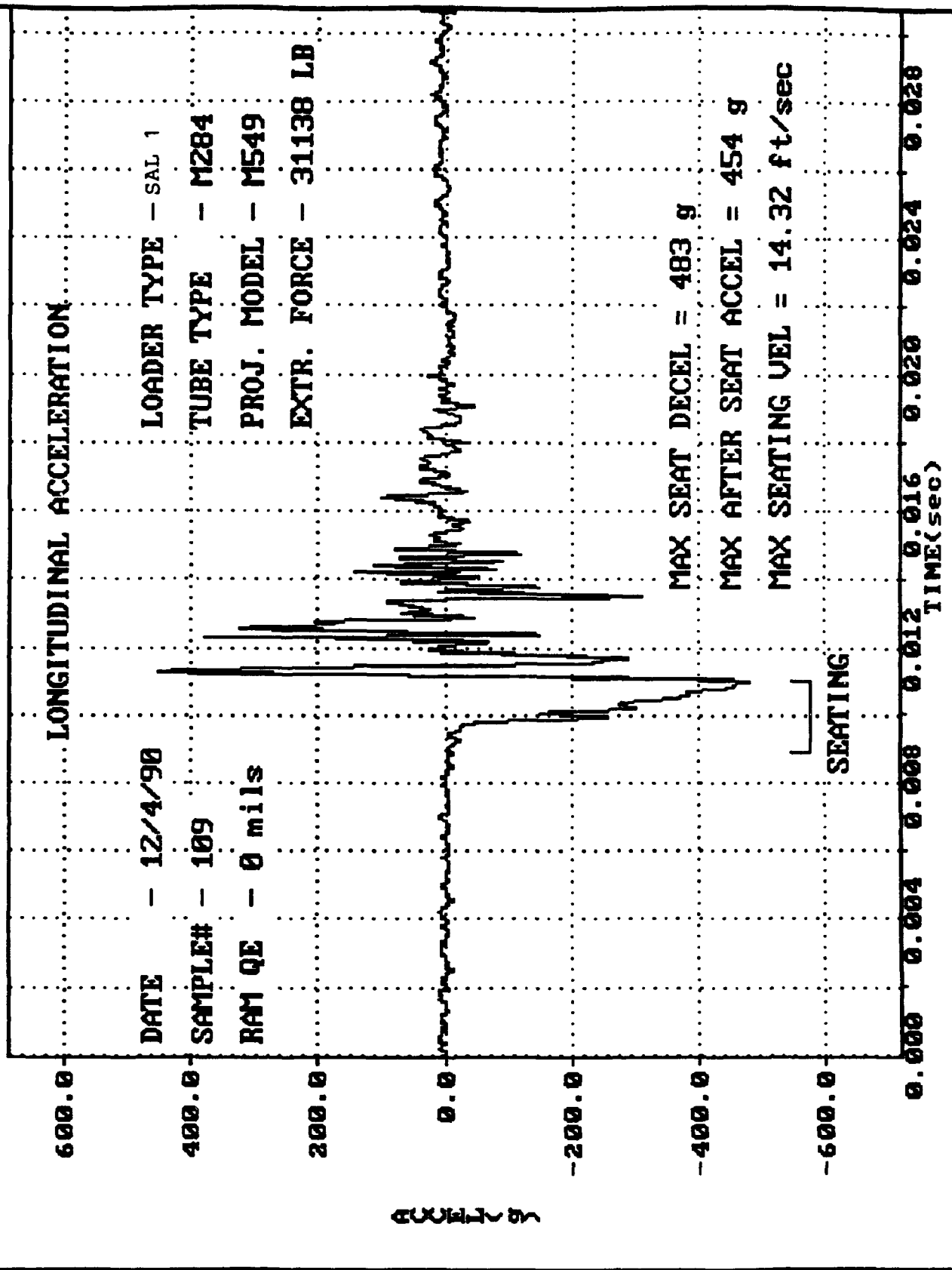
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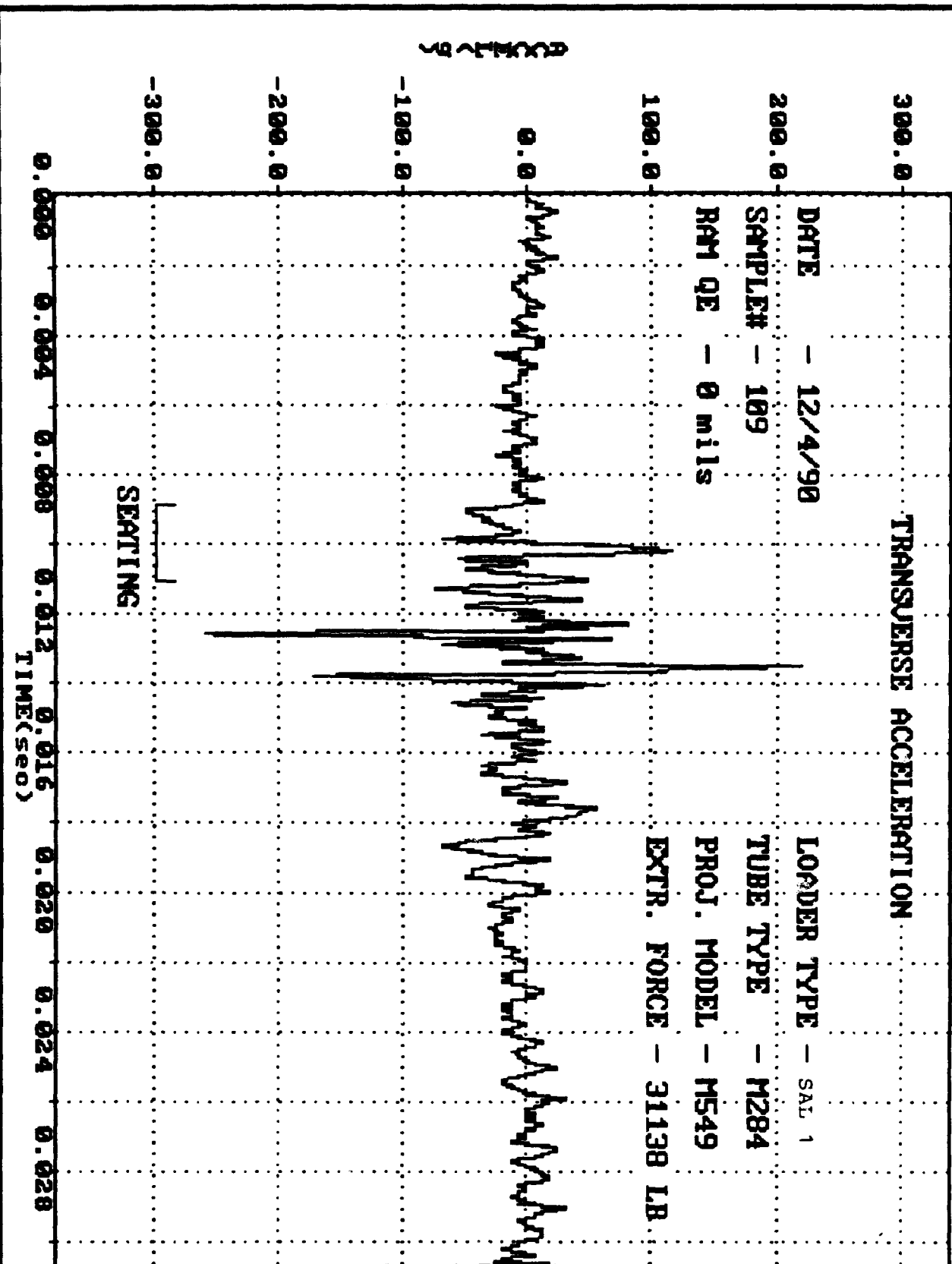
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# FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



# FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS



# FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS

## VERTICAL ACCELERATION

DATE - 12/4/90

LOADER TYPE - SAL 1

SAMPLE# - 109

TUBE TYPE - M284

RAM QE - 0 mls

PROJ. MODEL - M549

EXTR. FORCE - 31138 LB

ACCELERATION

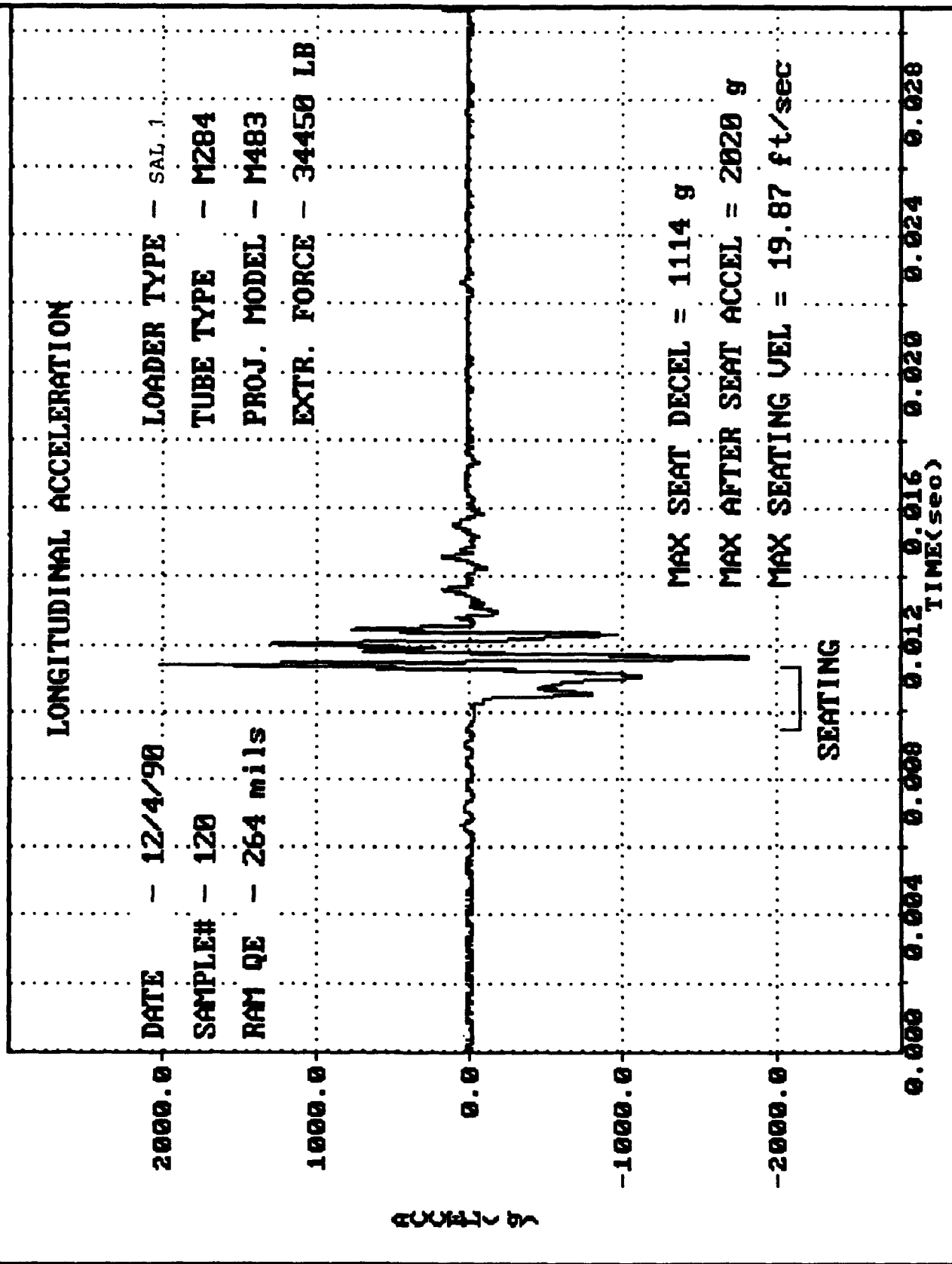
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-200.0  
0.0

SEATING

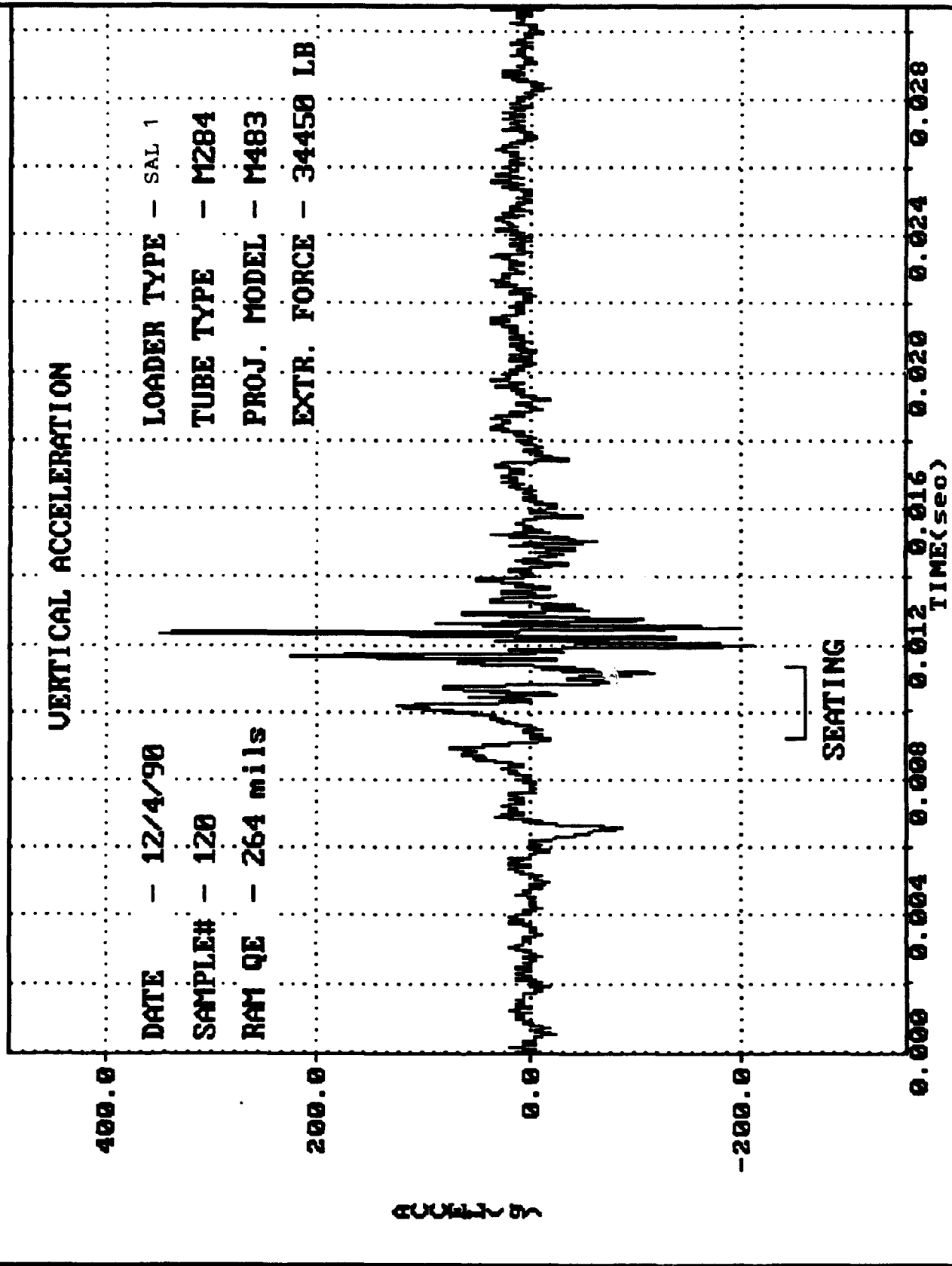
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TIME(sec)



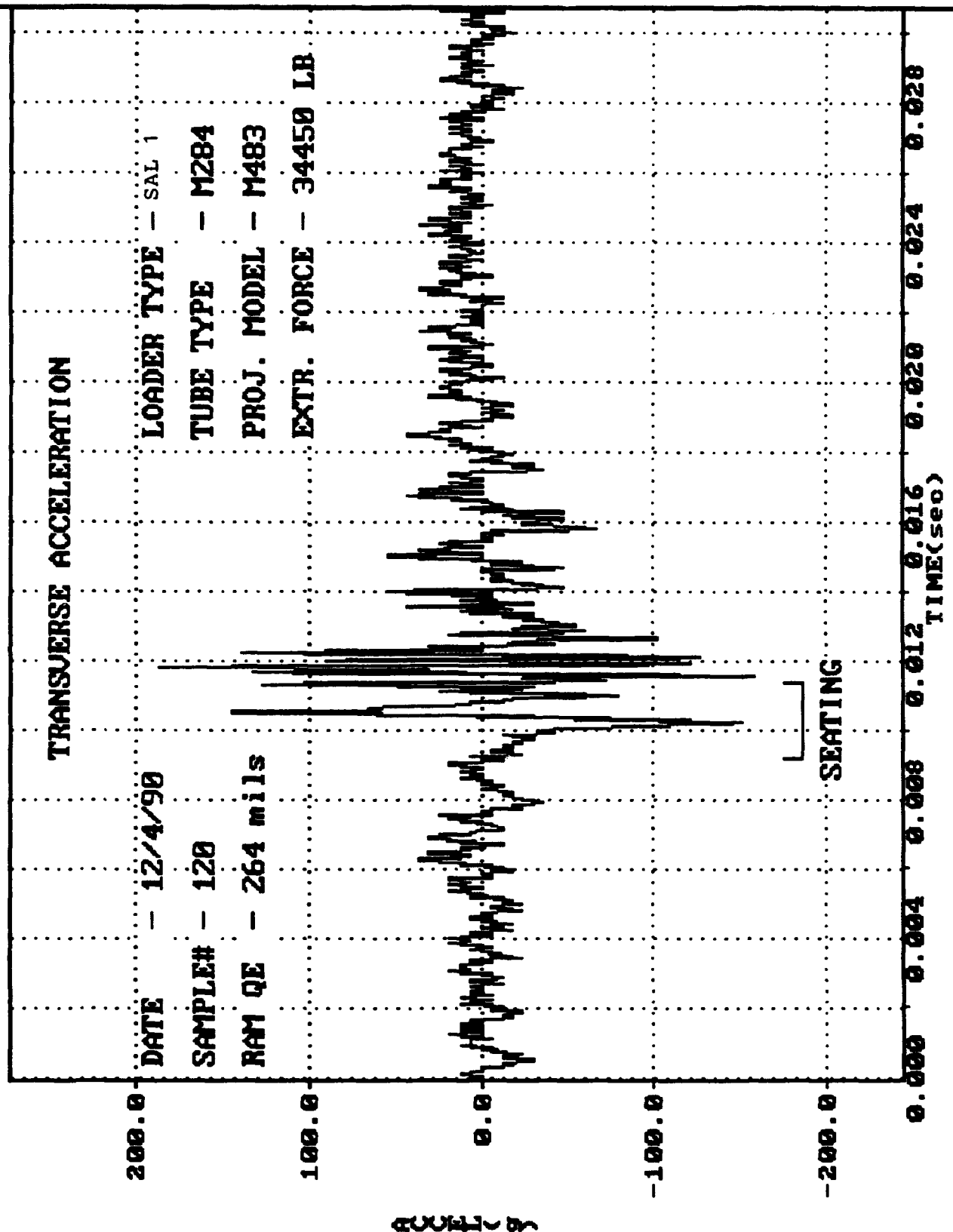
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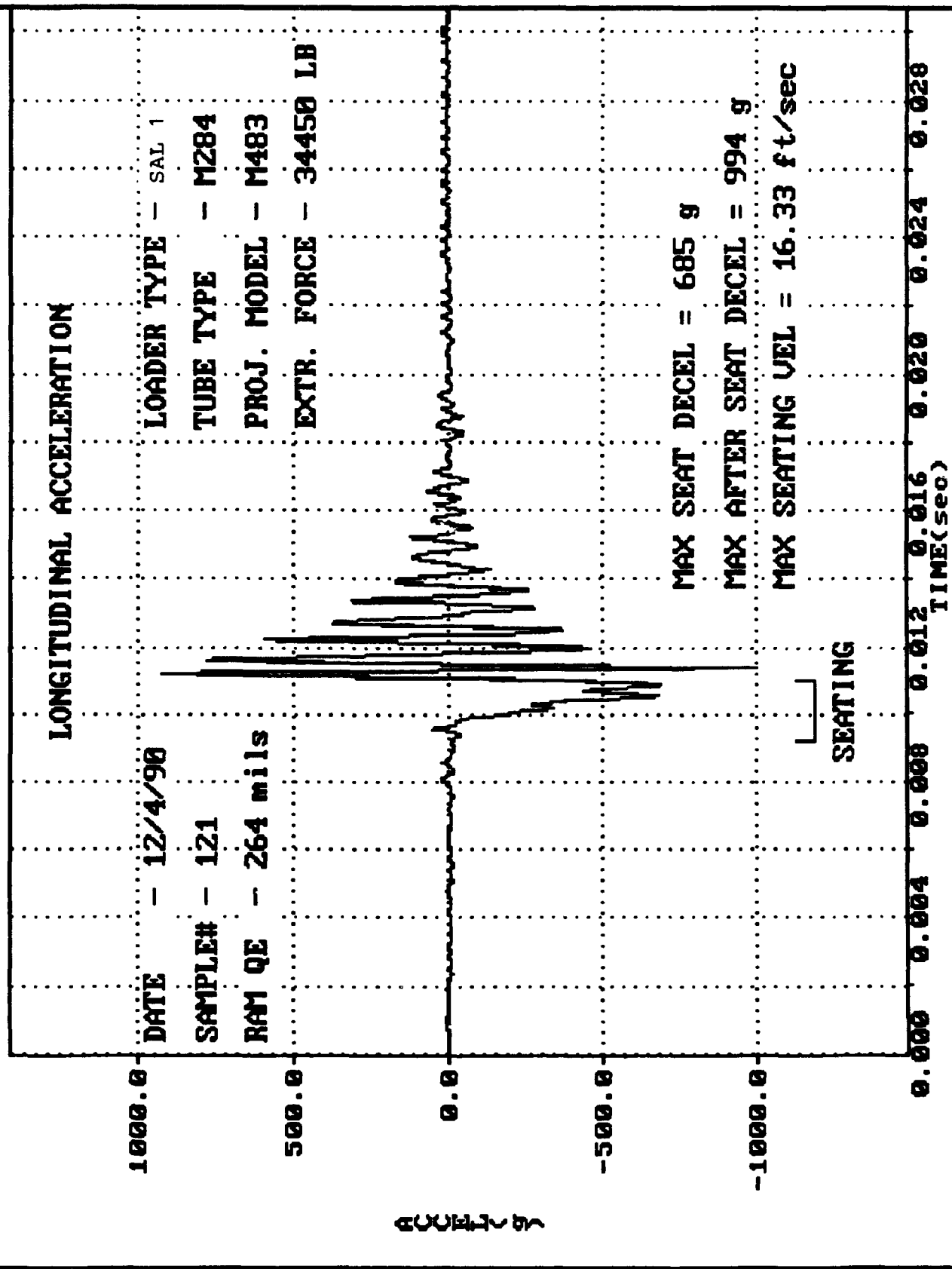
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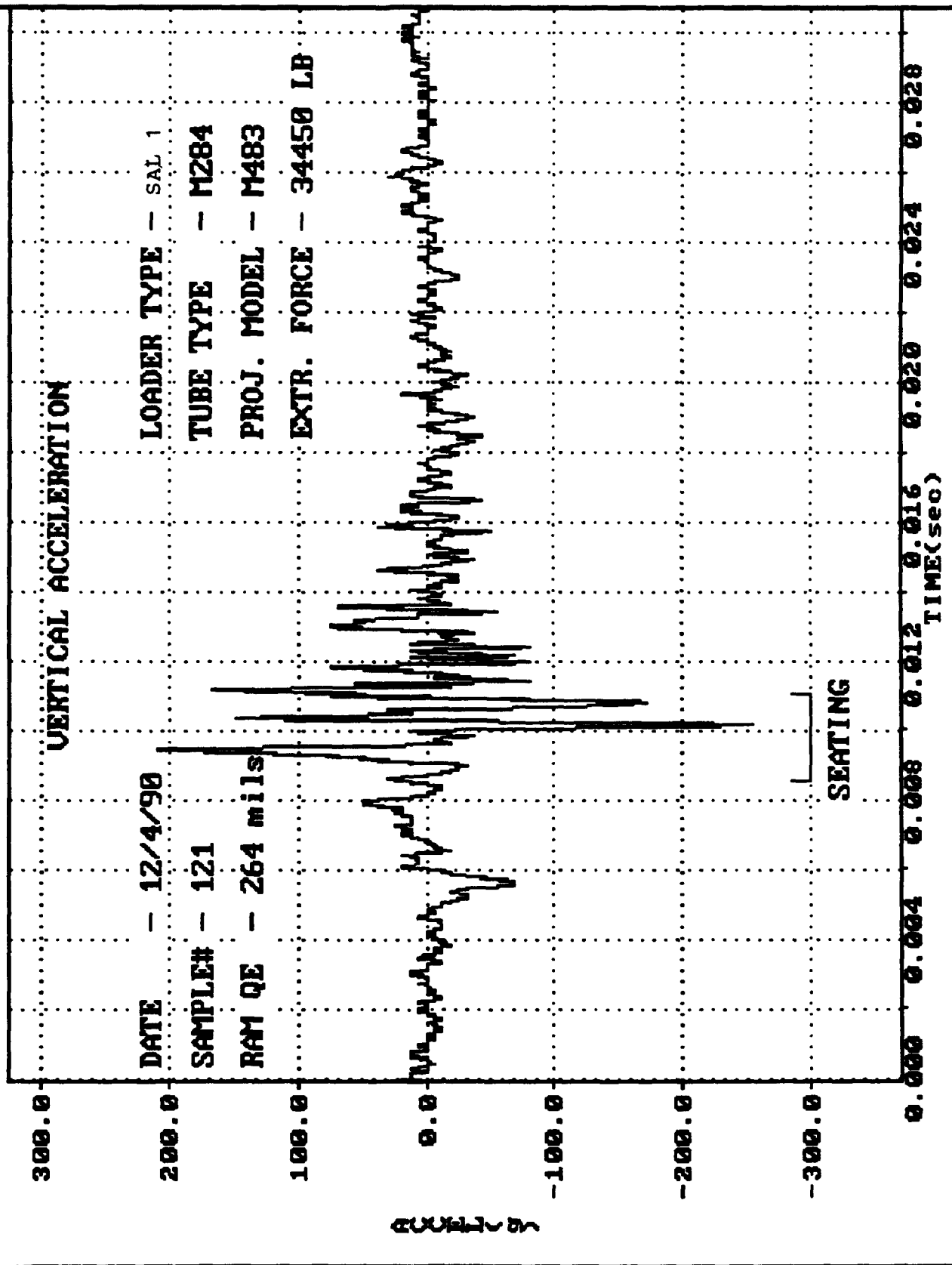
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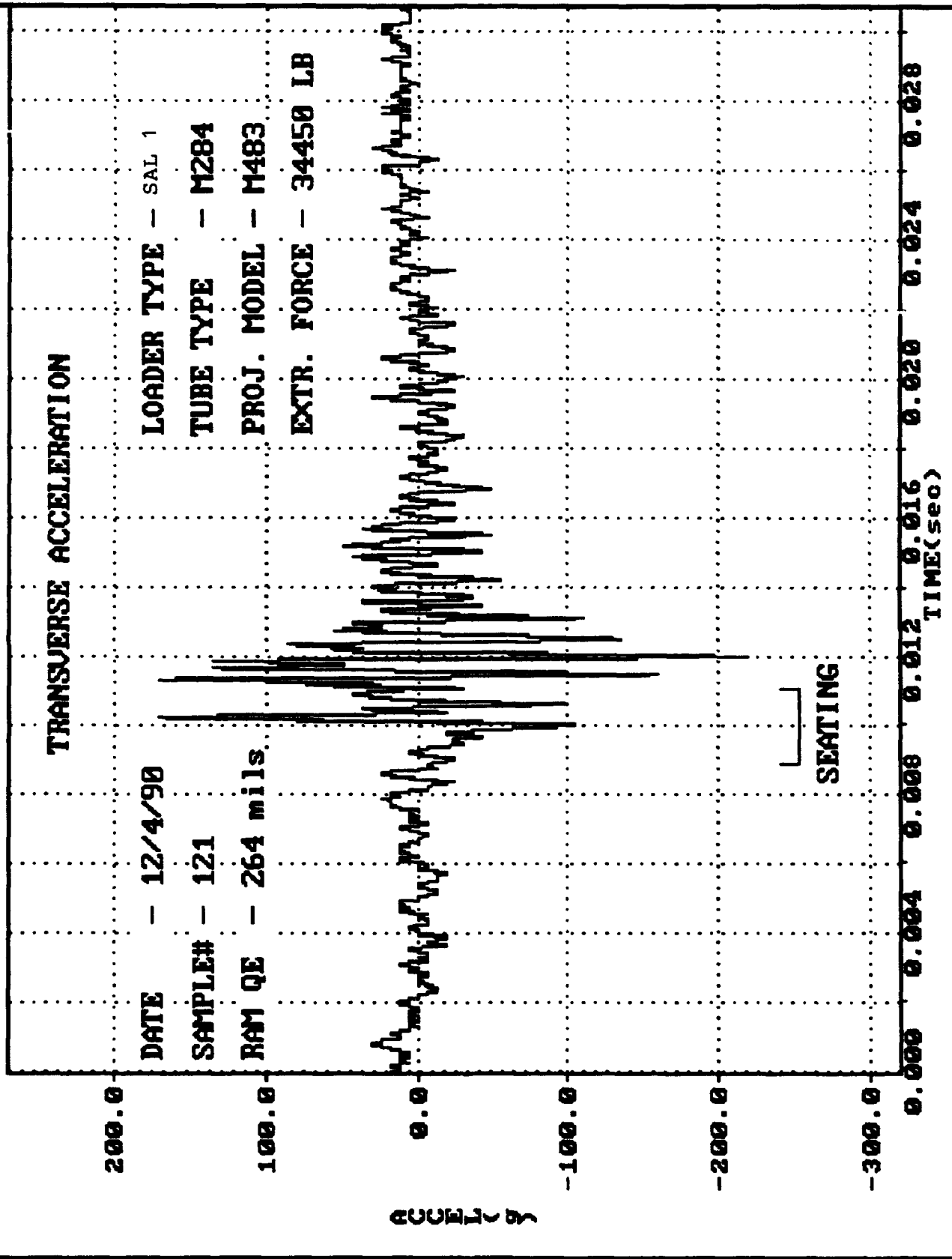
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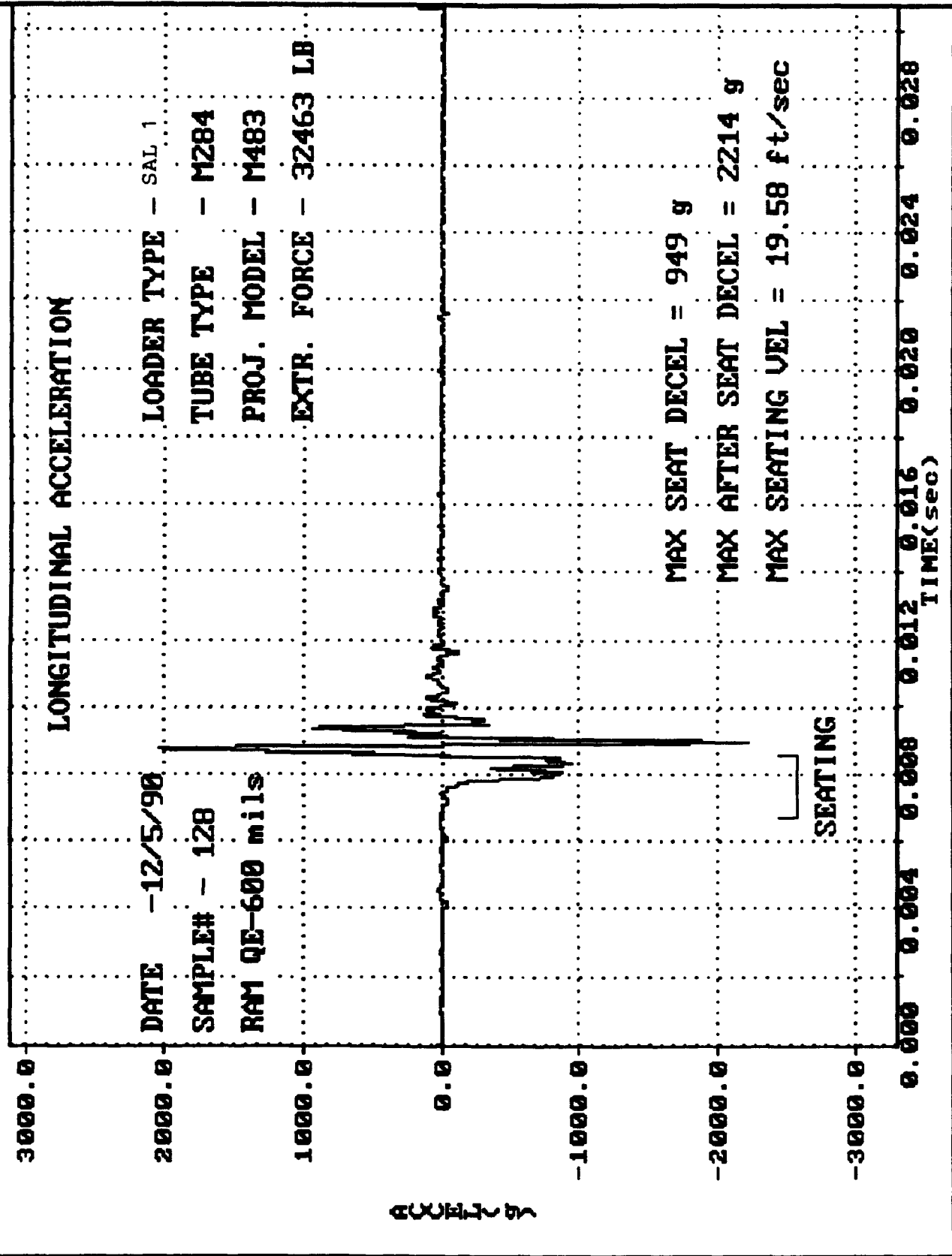
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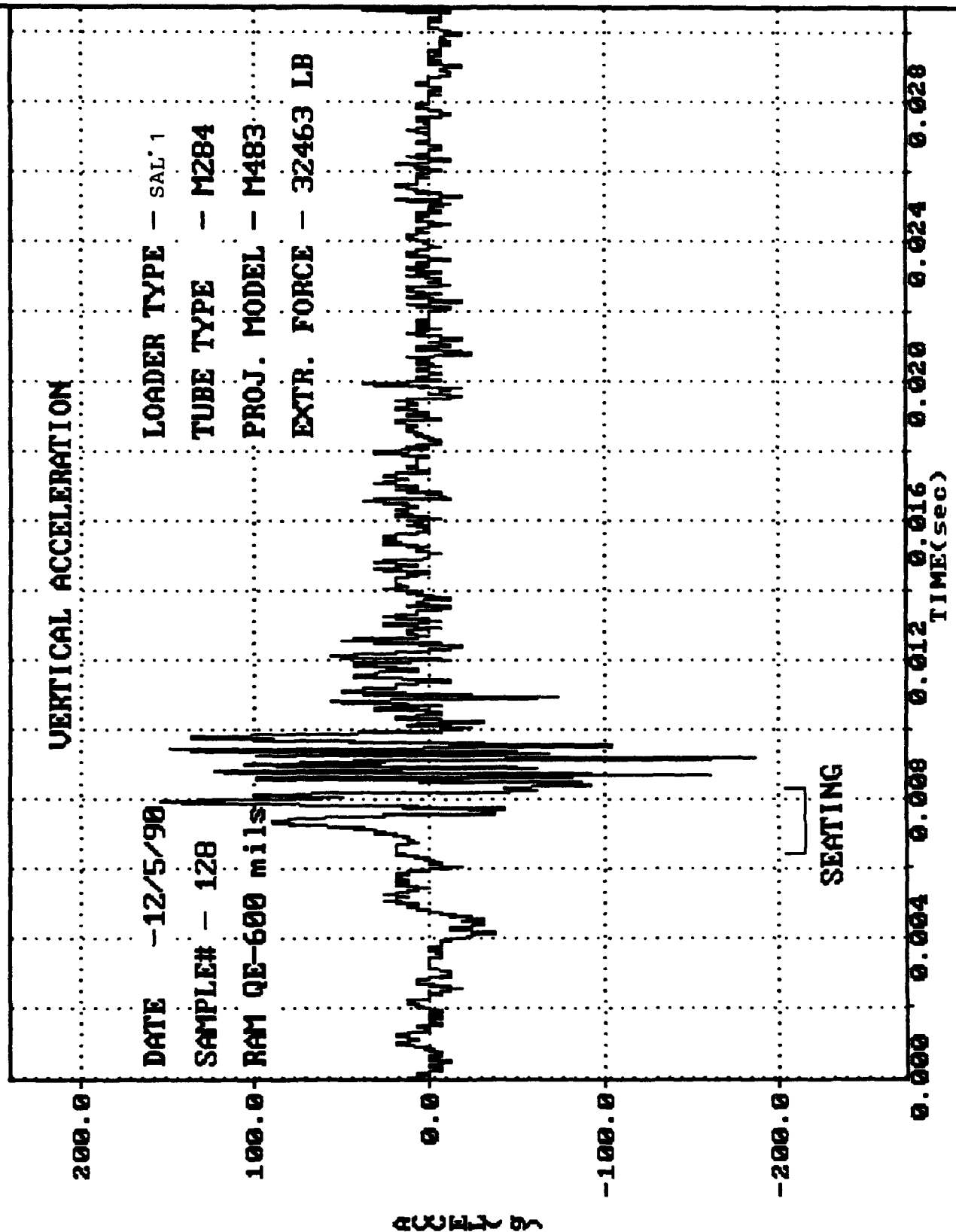
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# FOREIGN COMPARATIVE TESTING: SEMIAUTOMATIC LOADERS

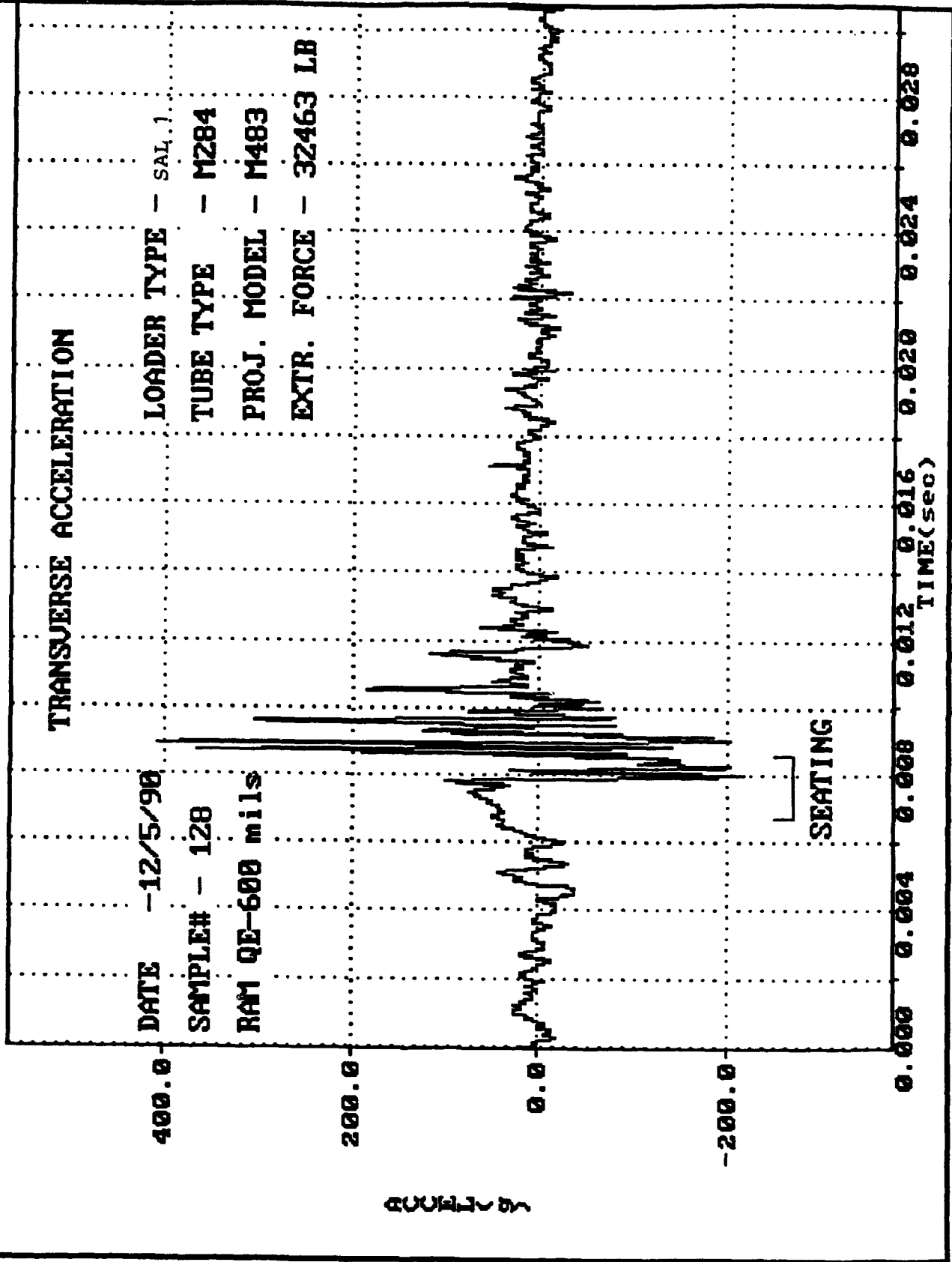


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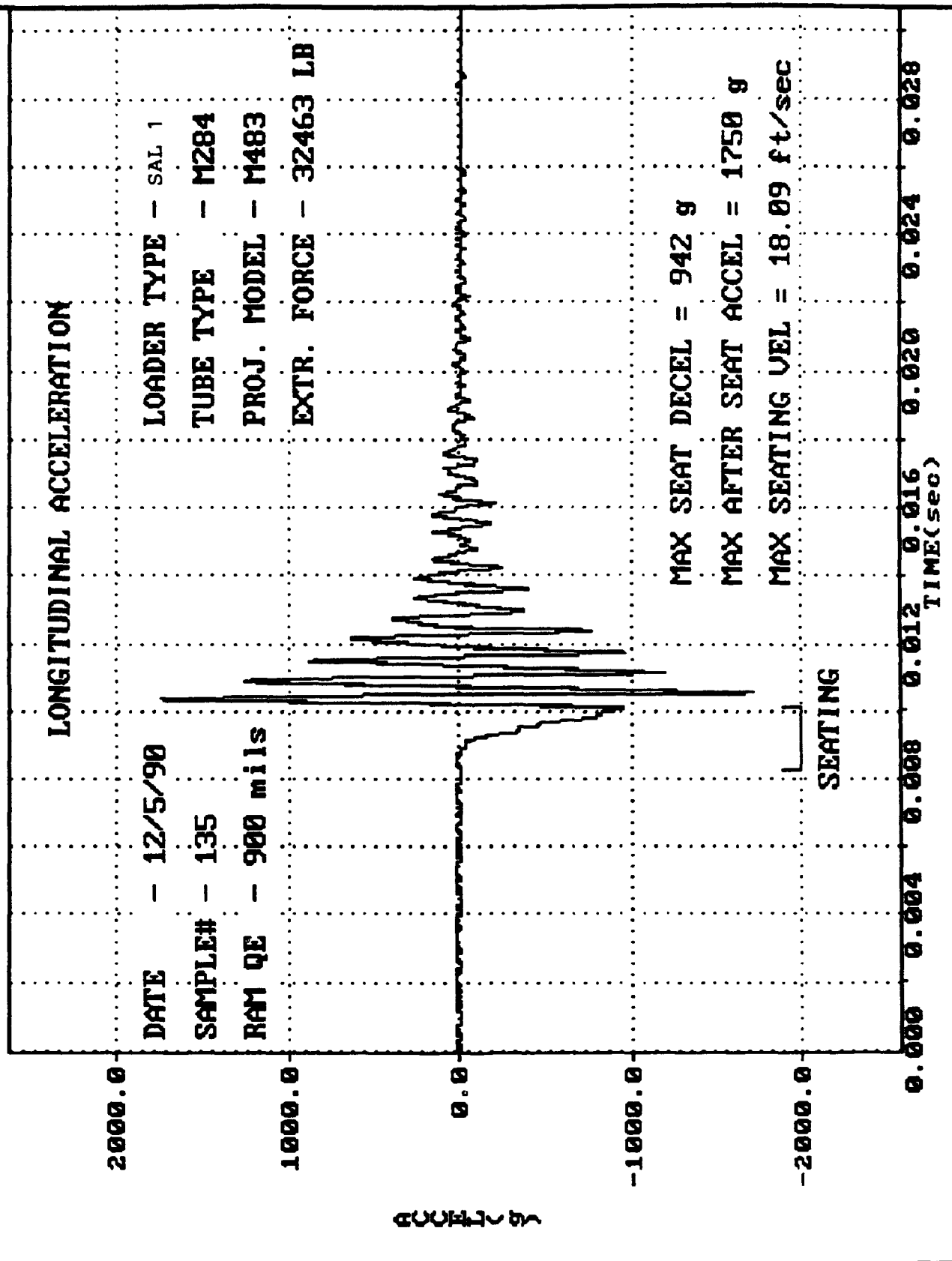




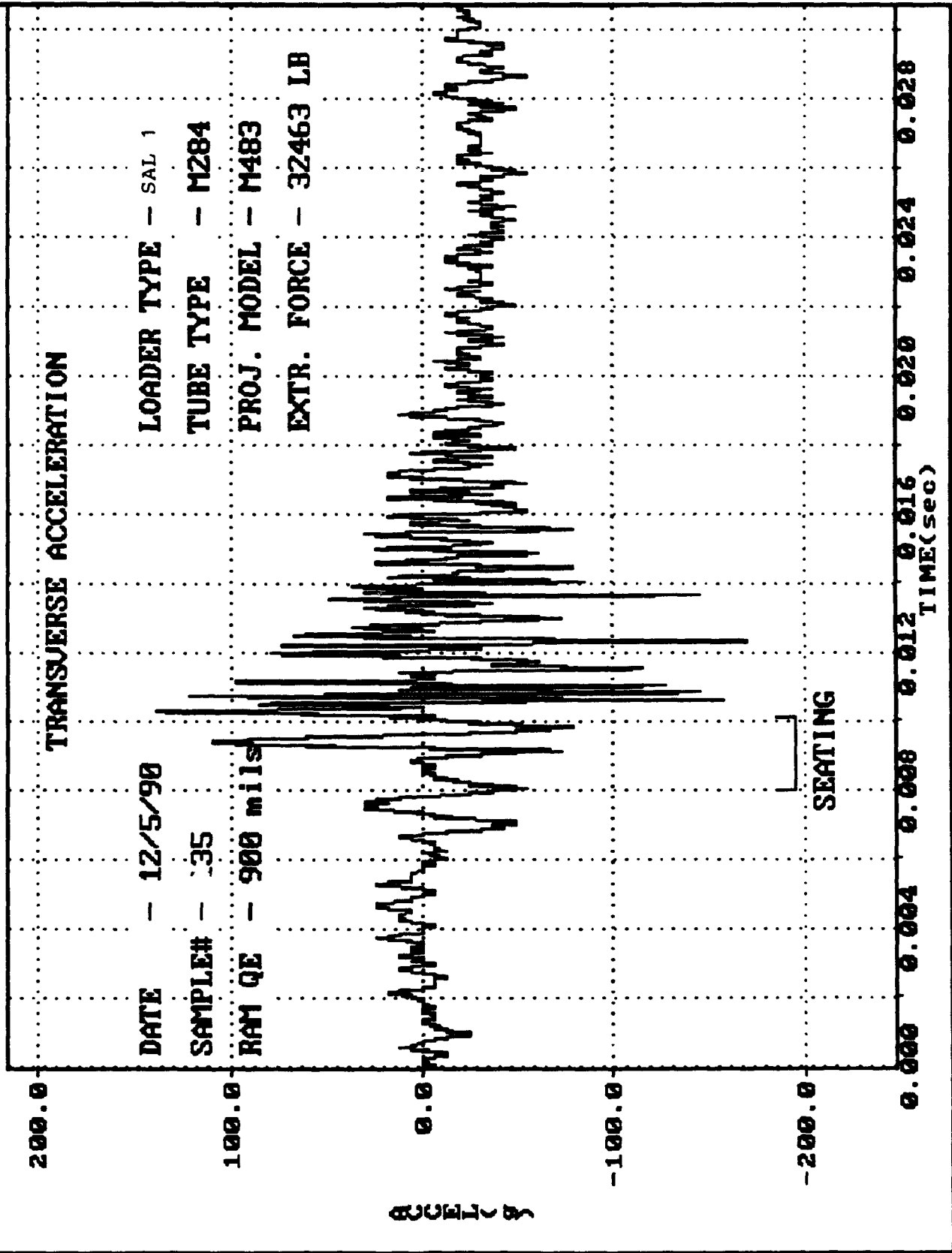
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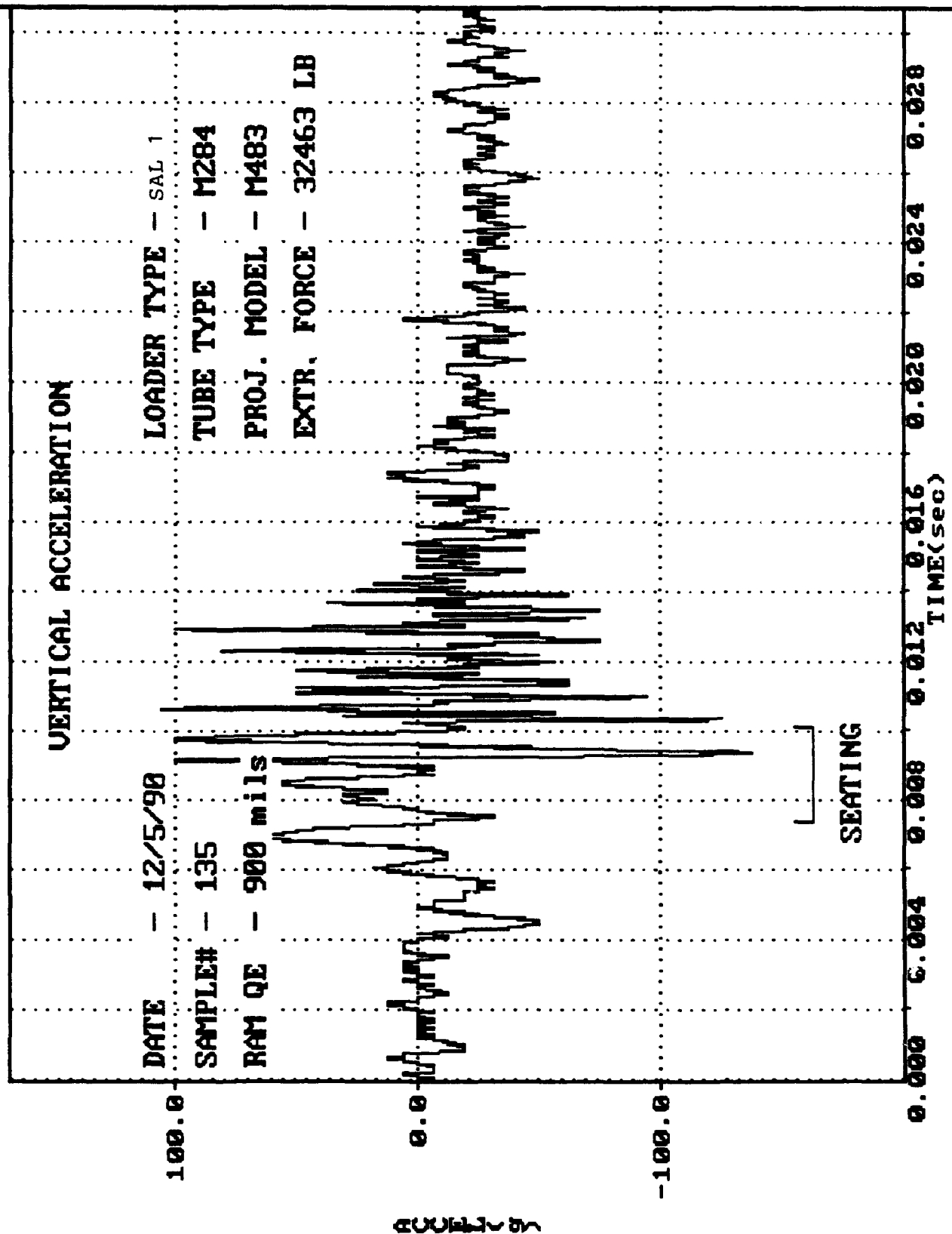
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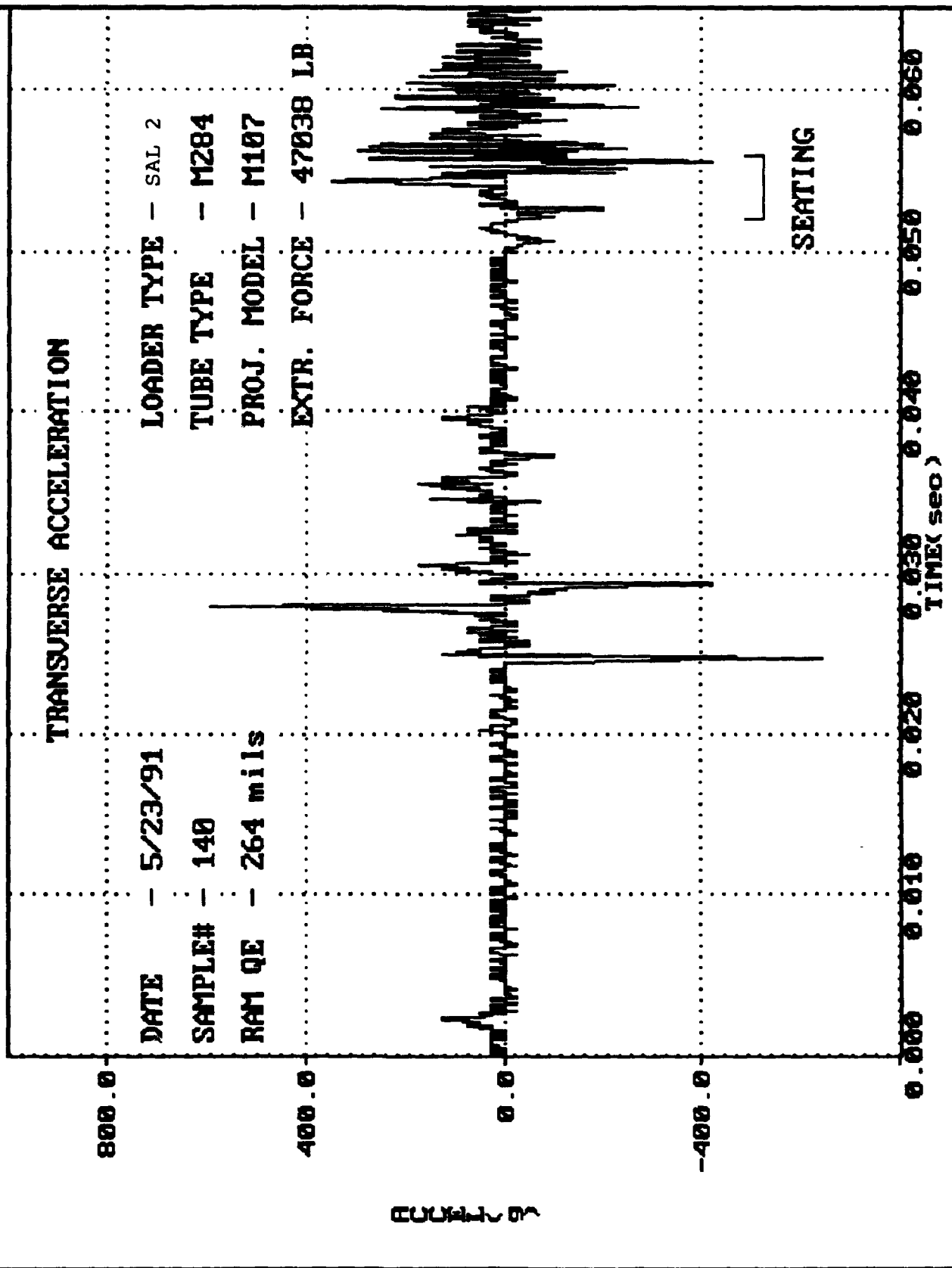
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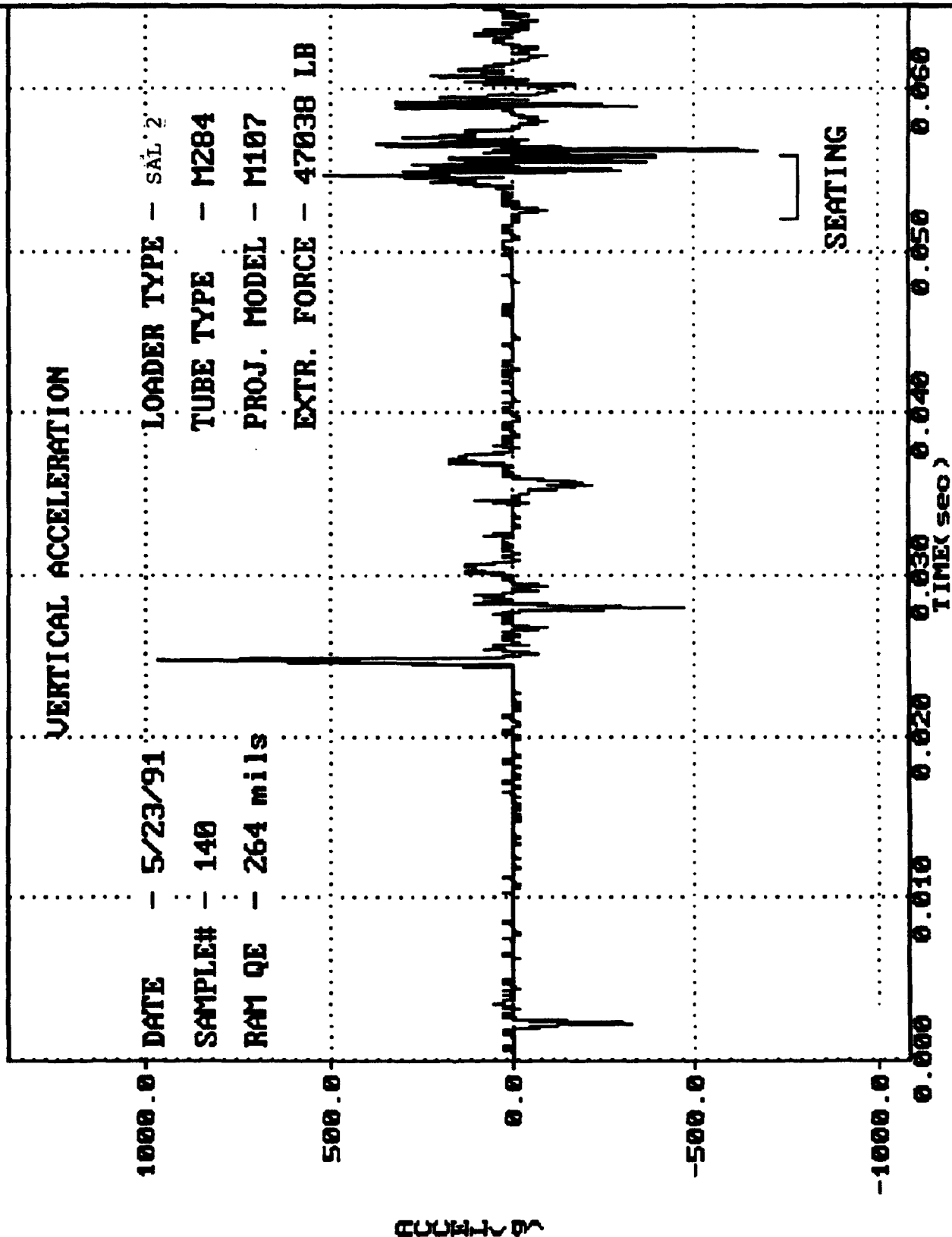
**APPENDIX C**

**KW RAMS**

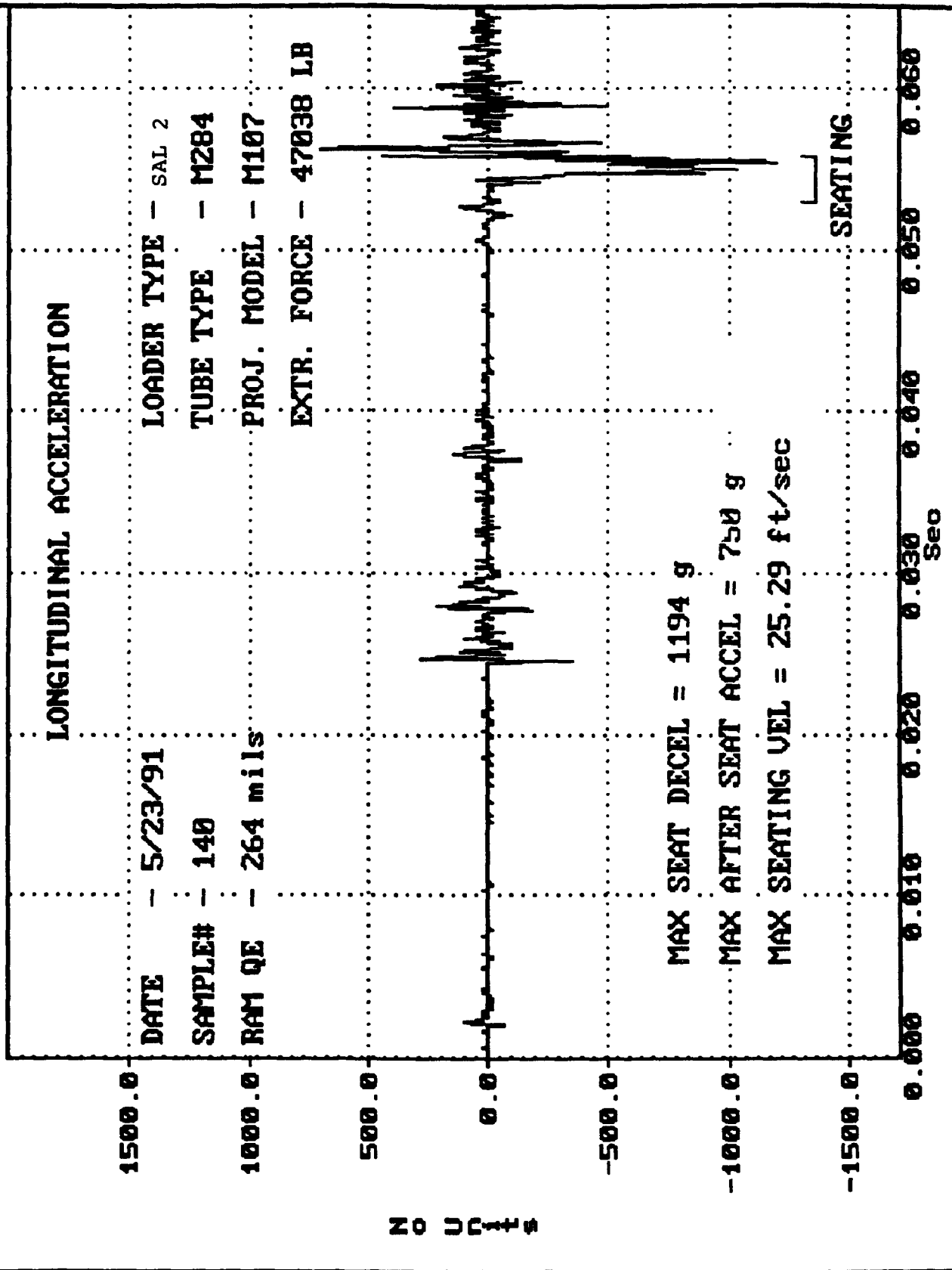
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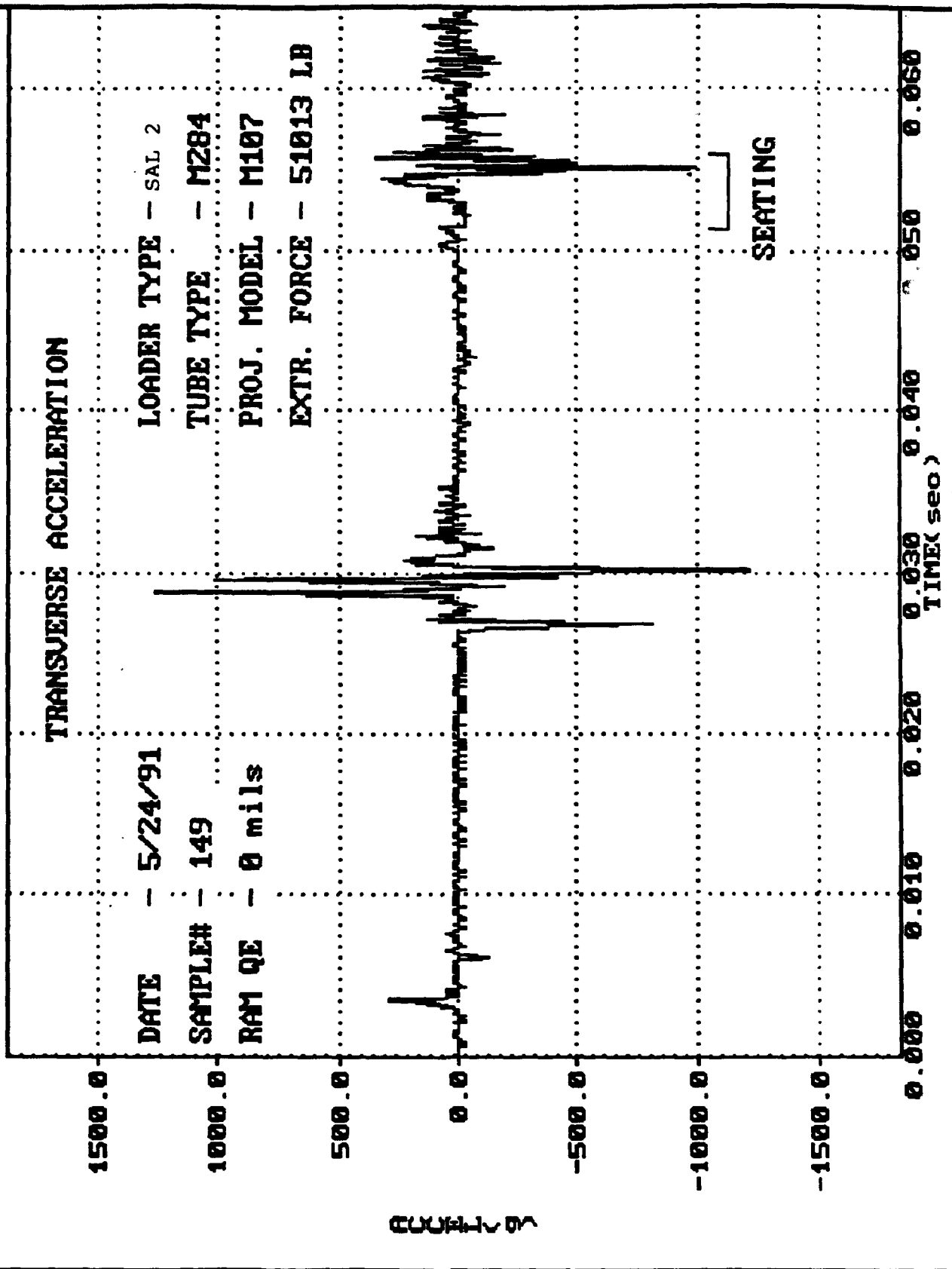


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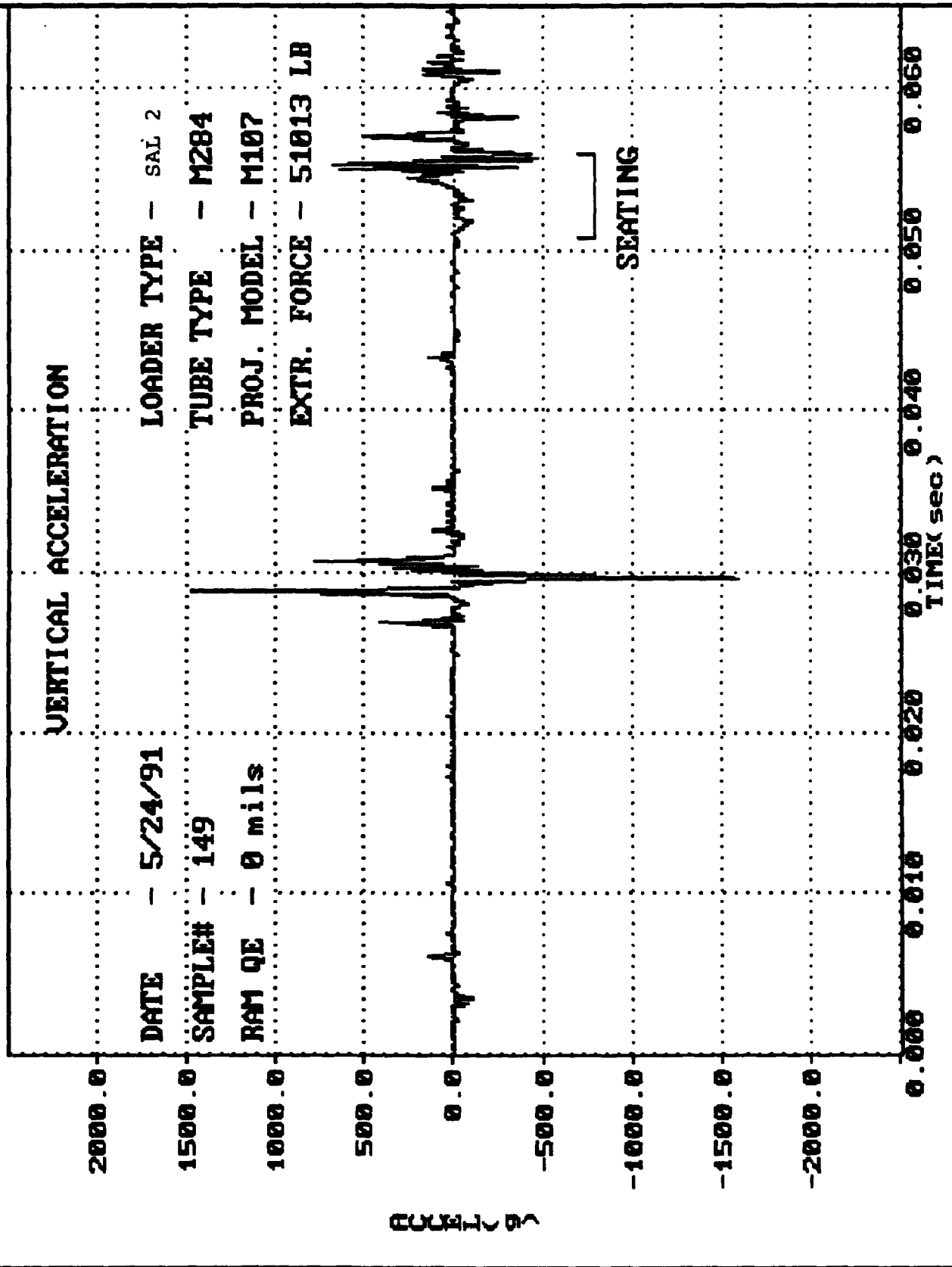




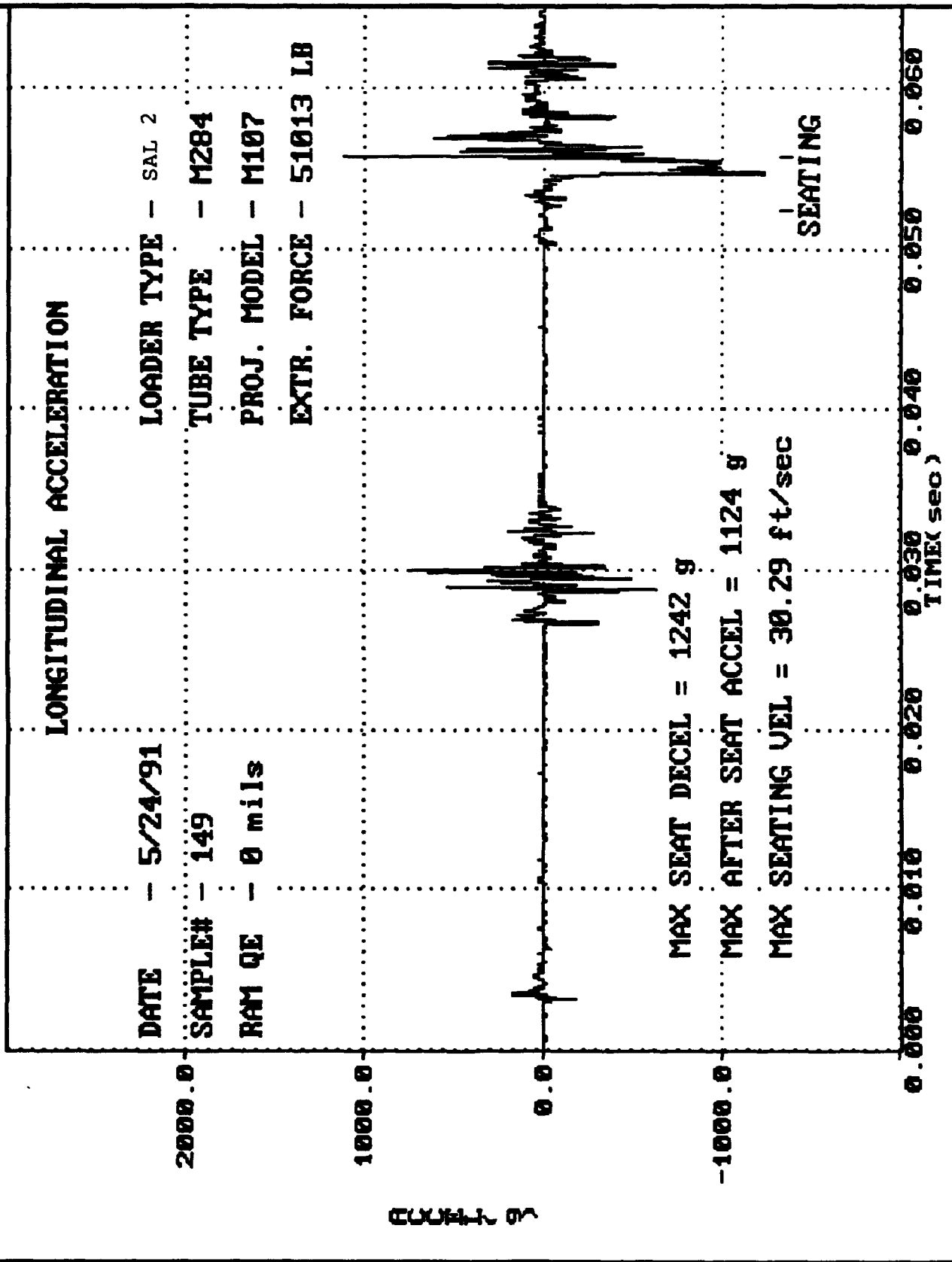
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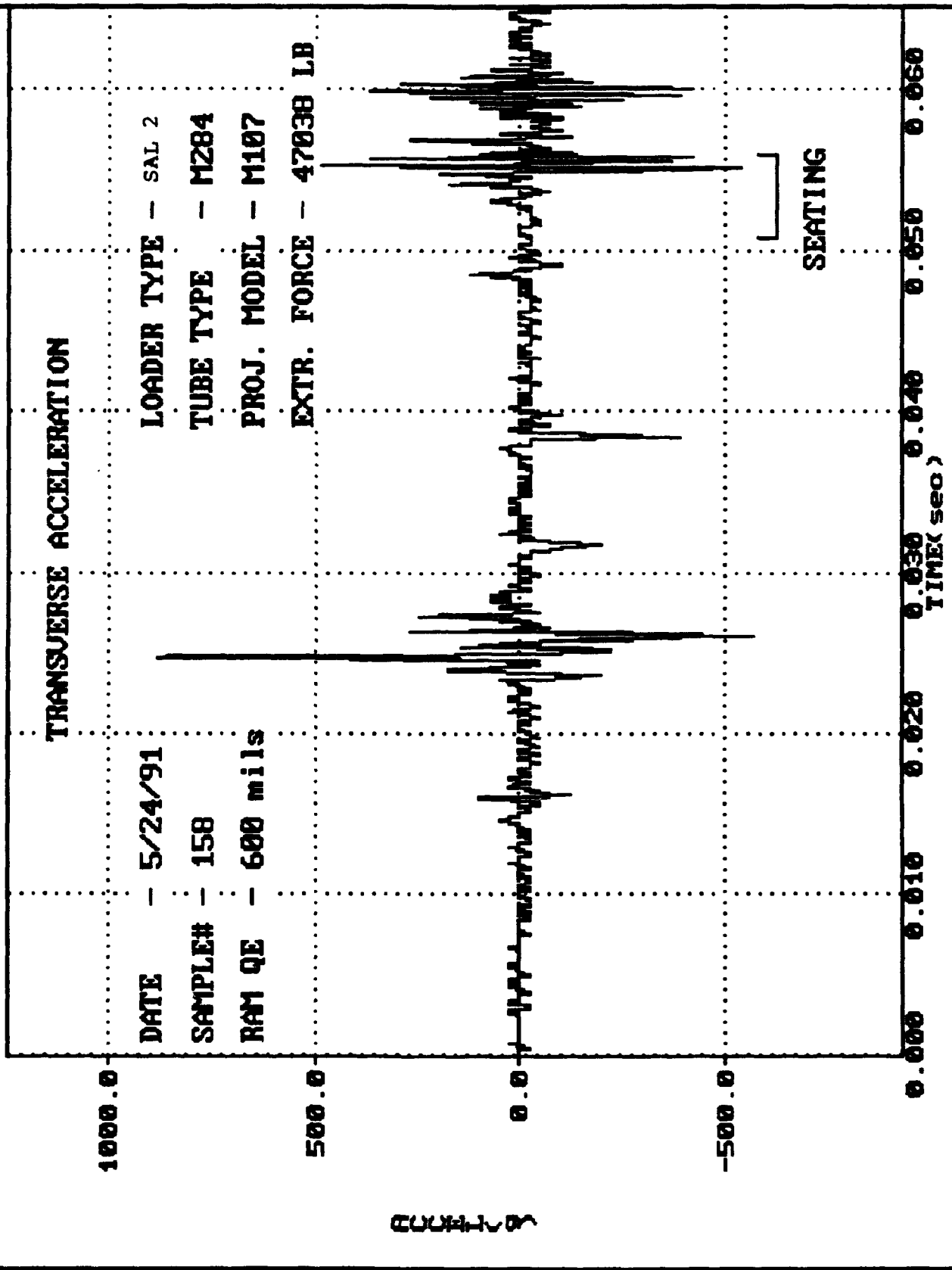
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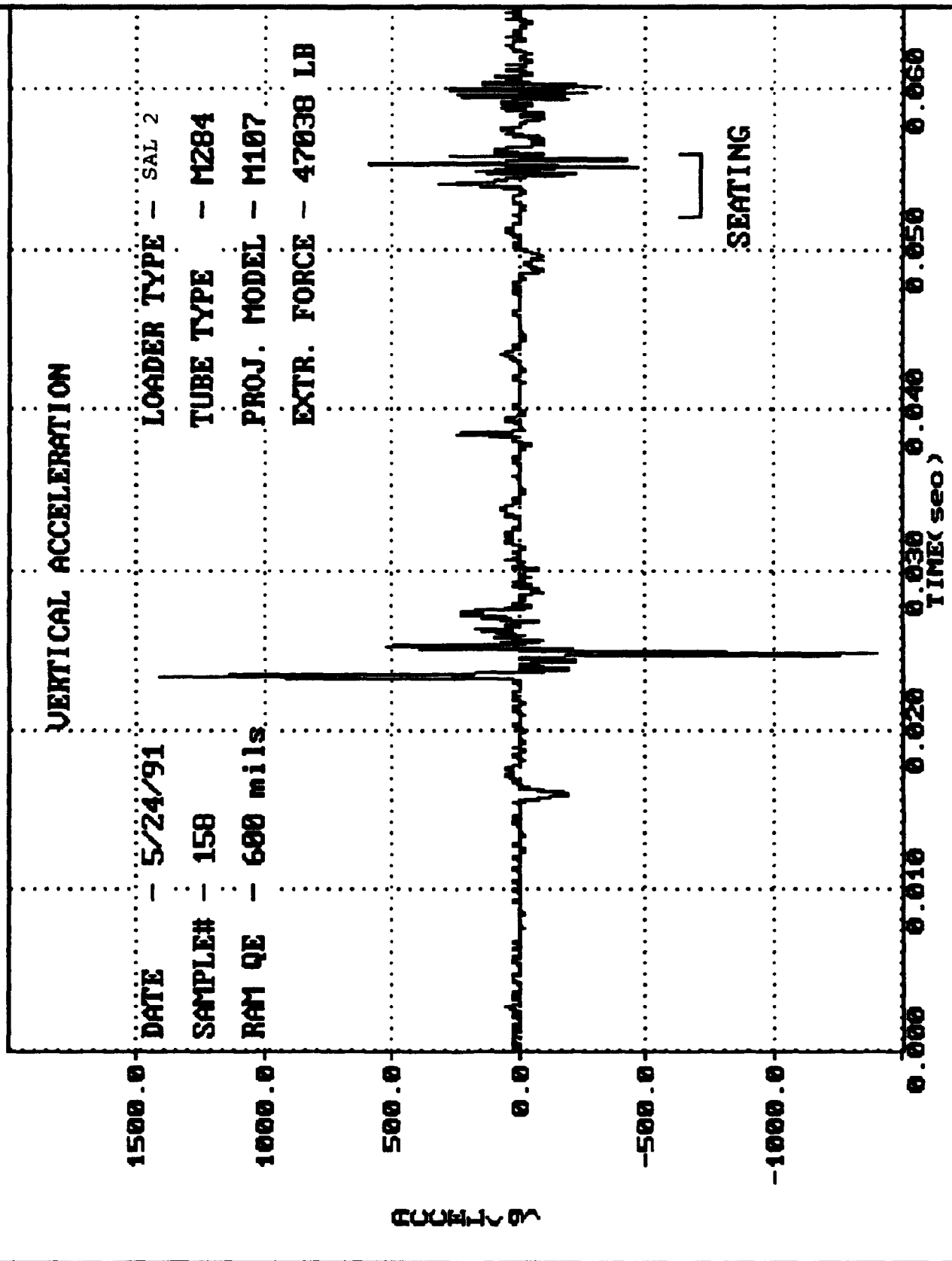
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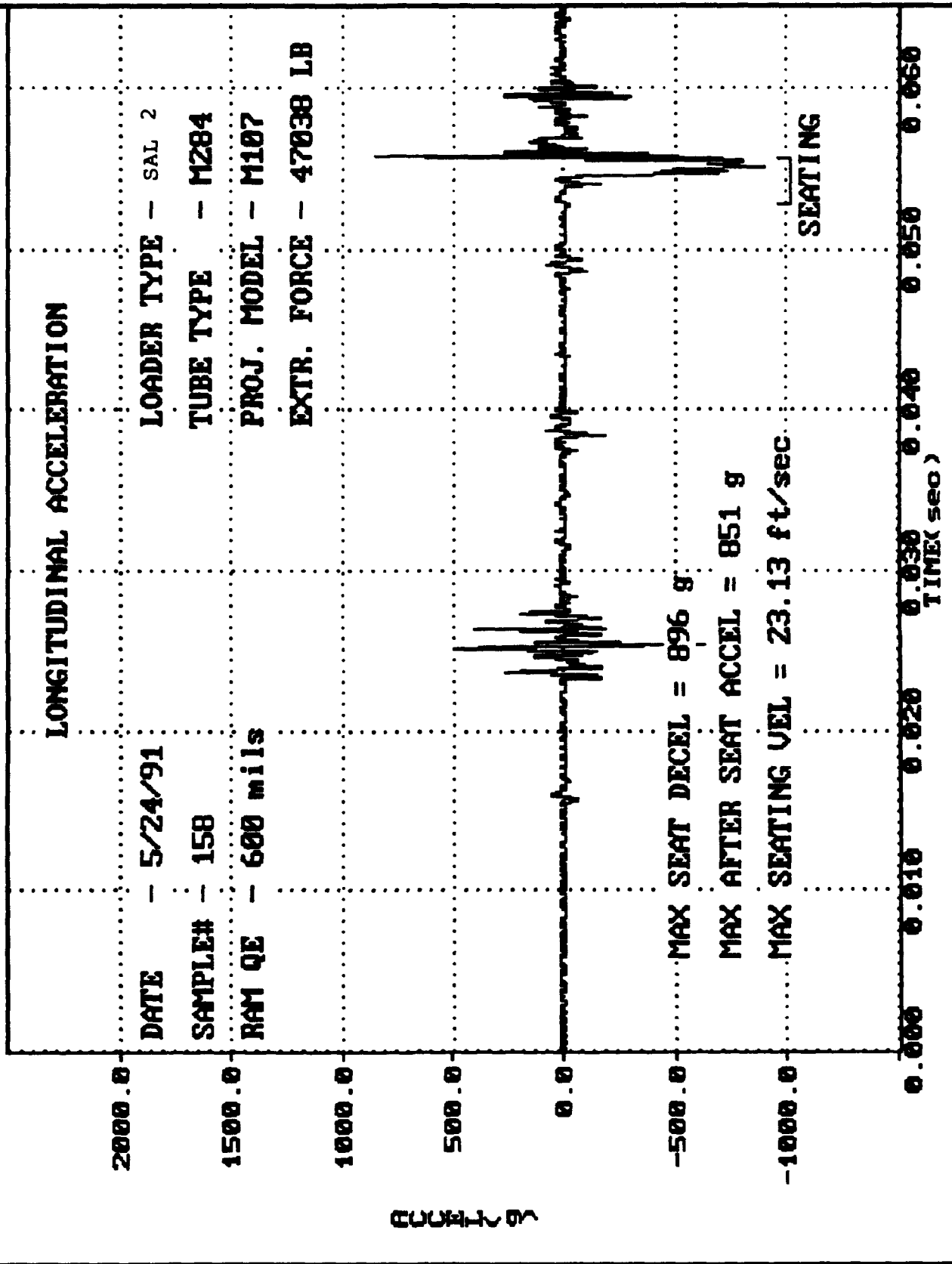
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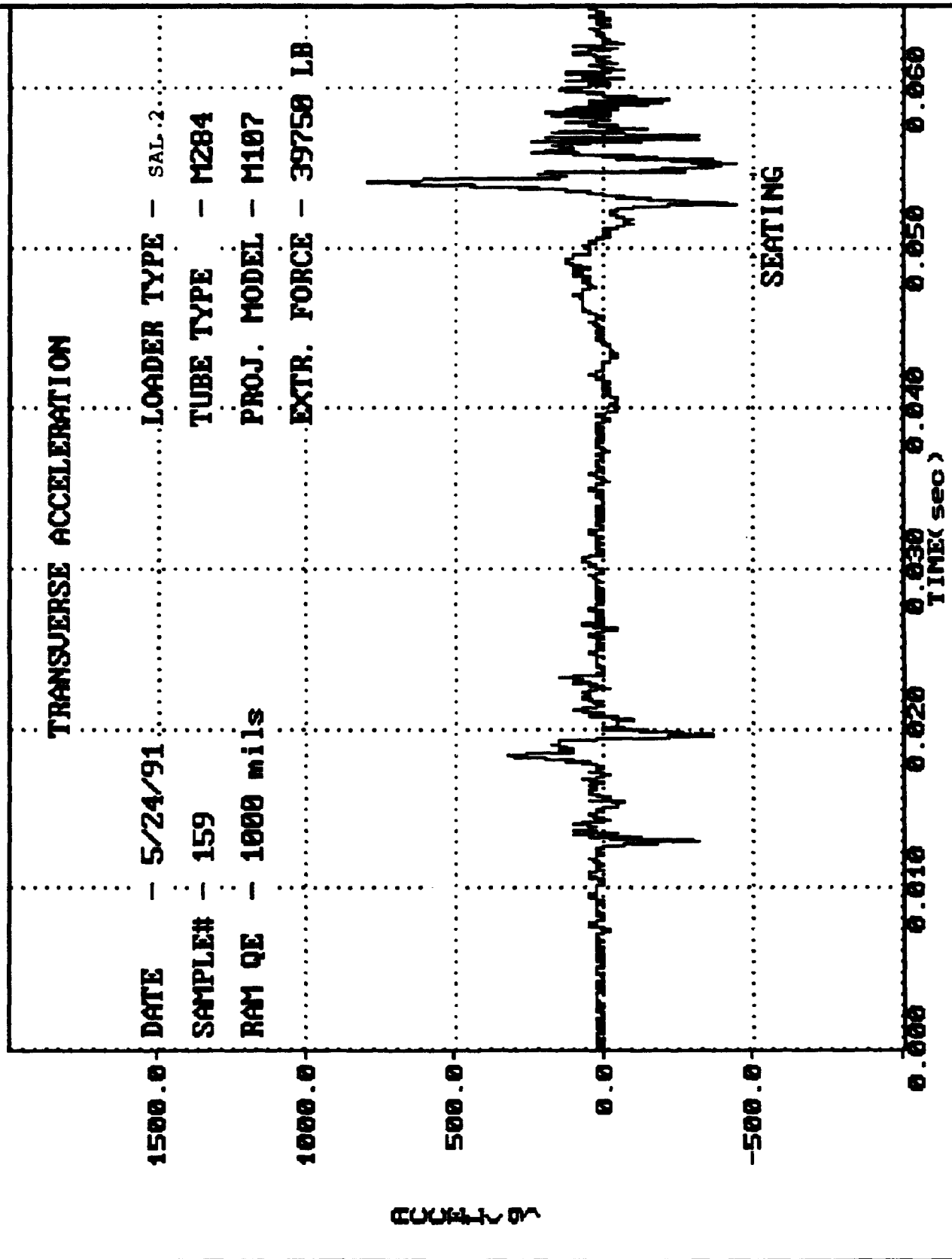
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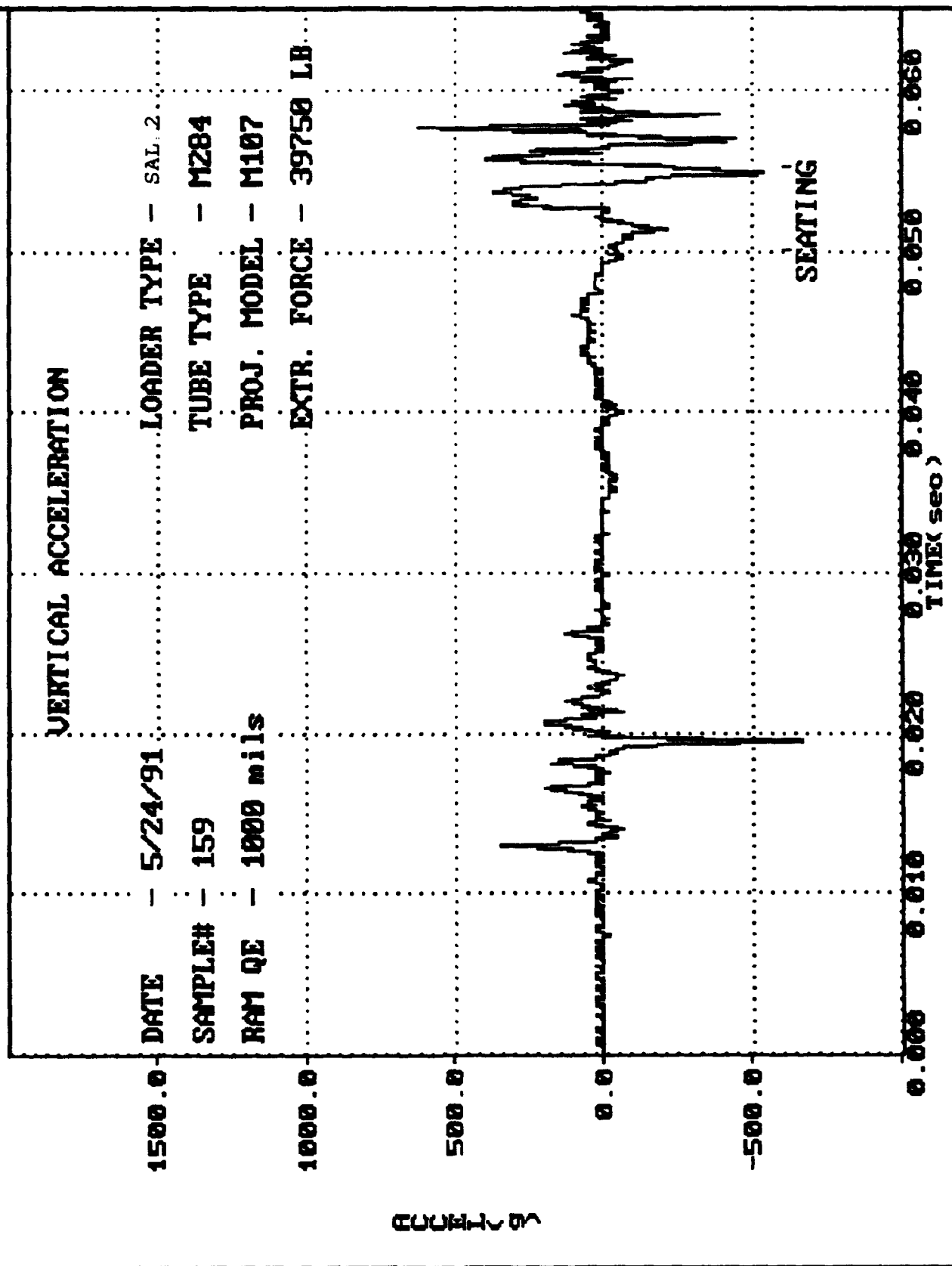
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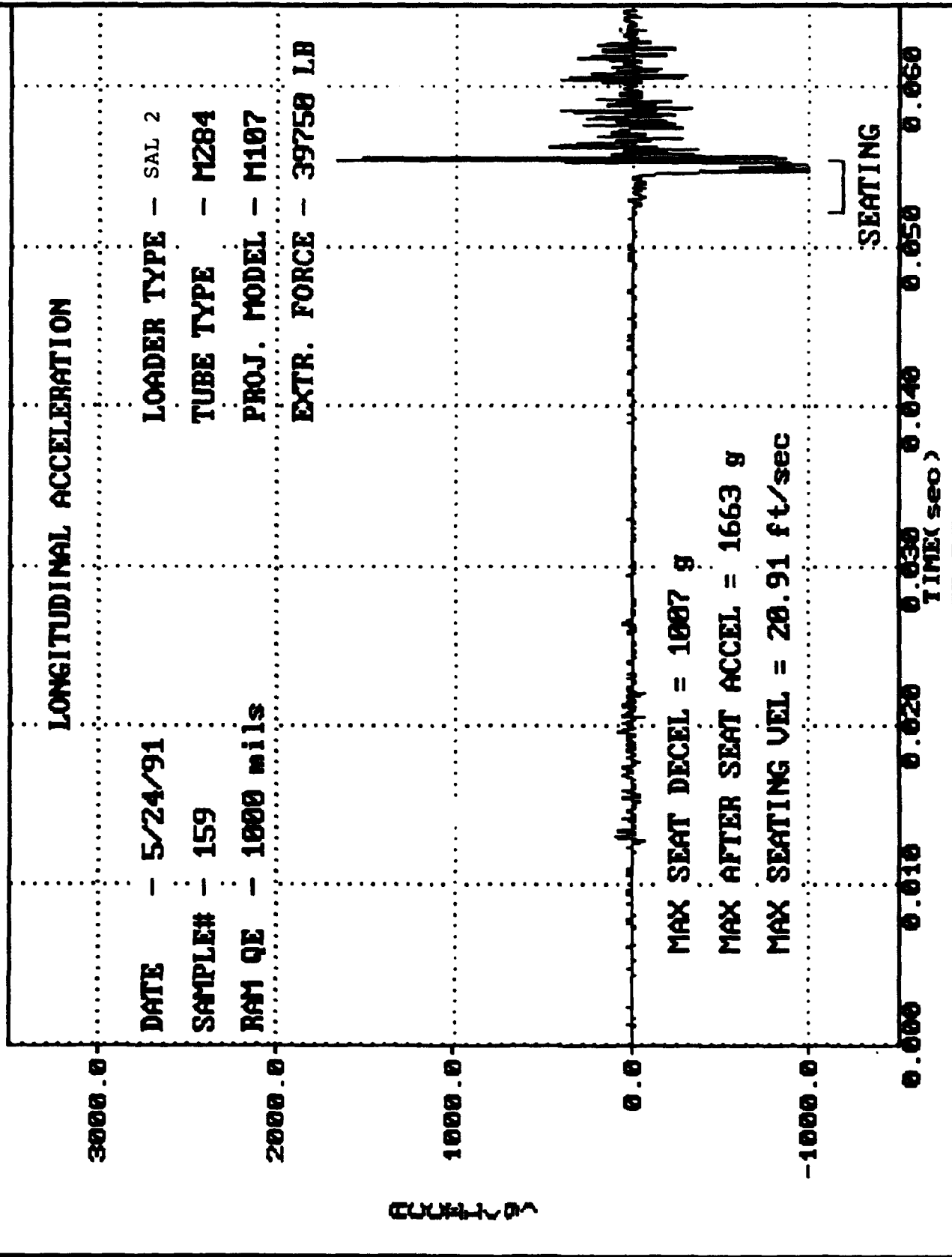


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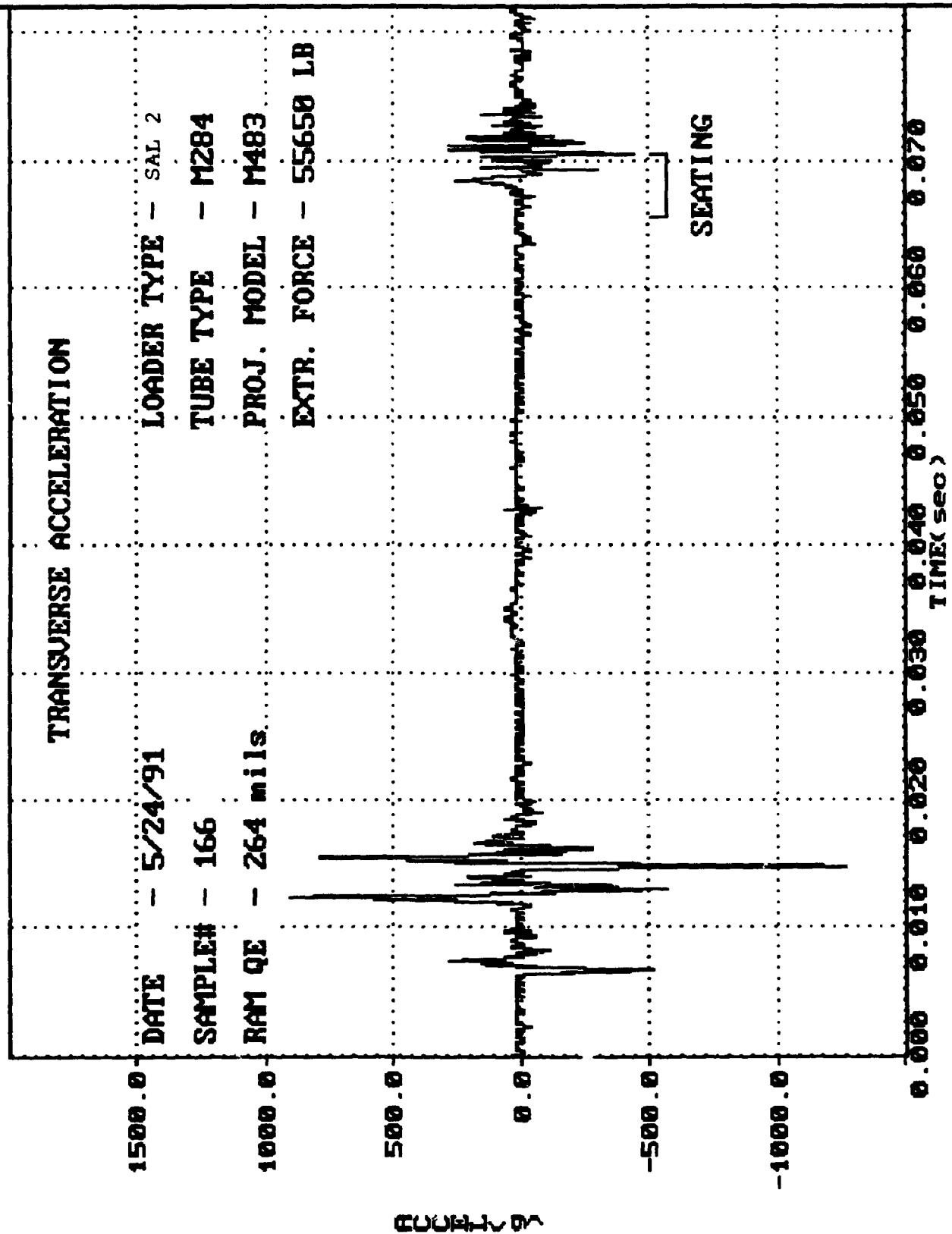




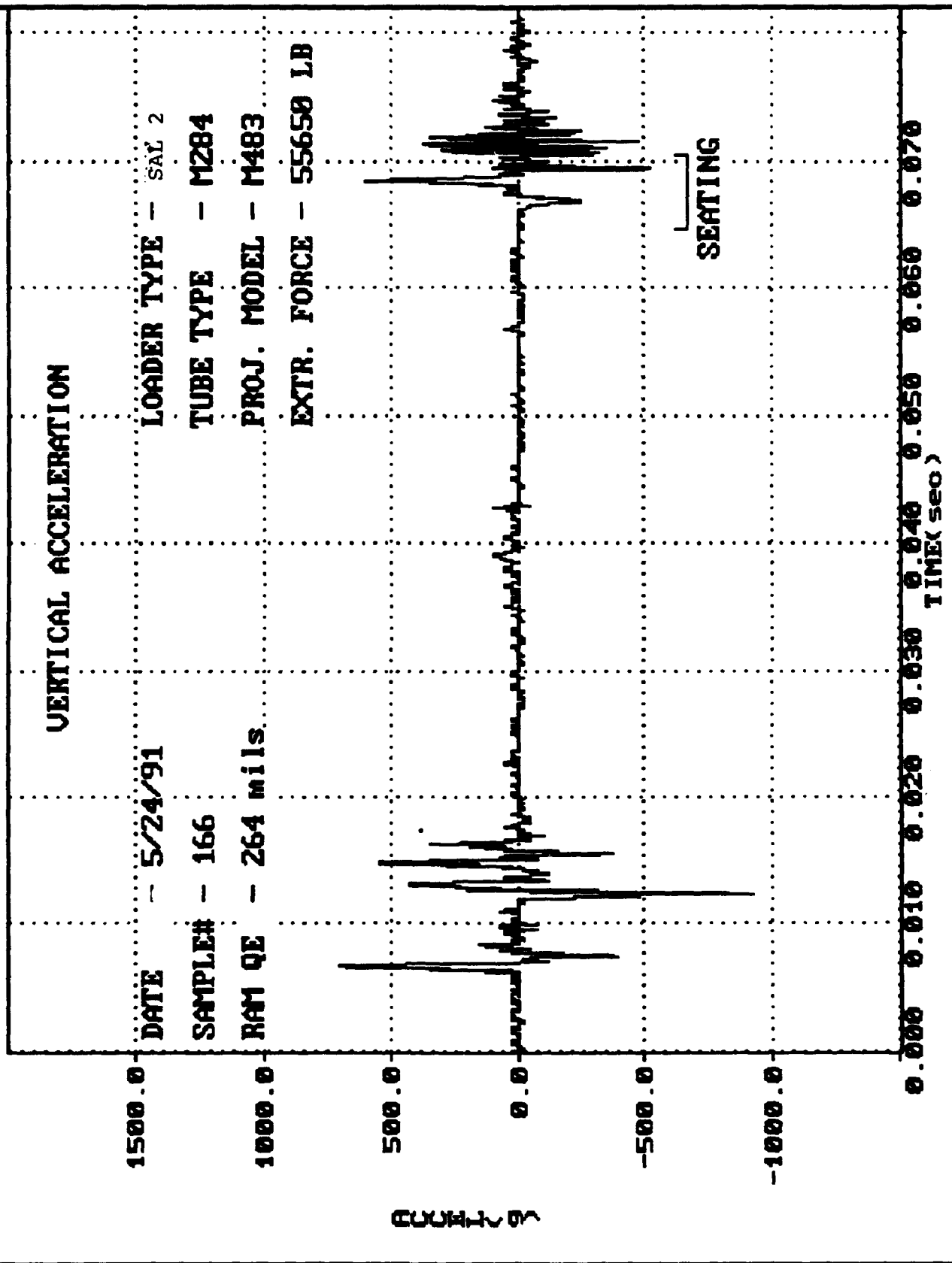
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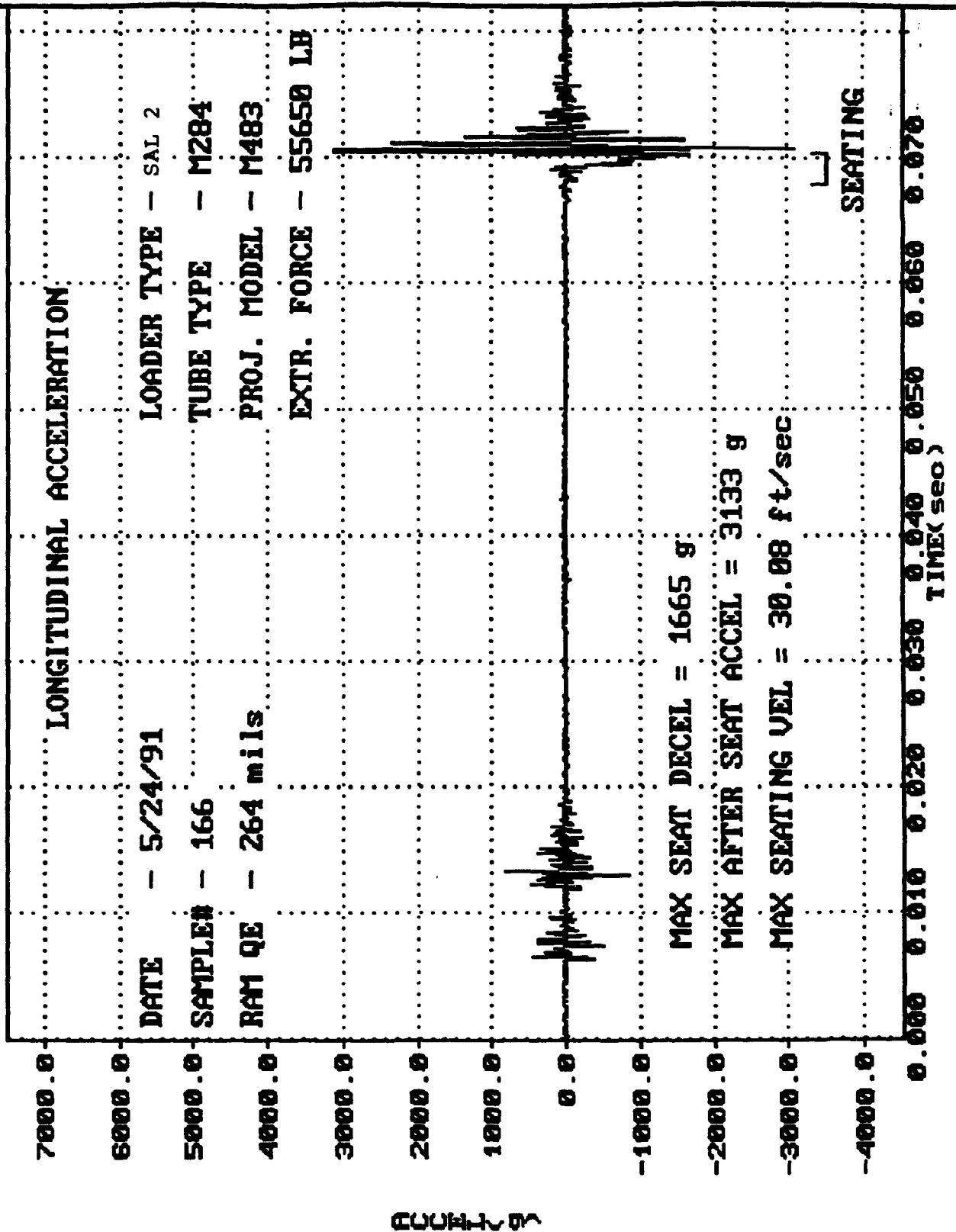
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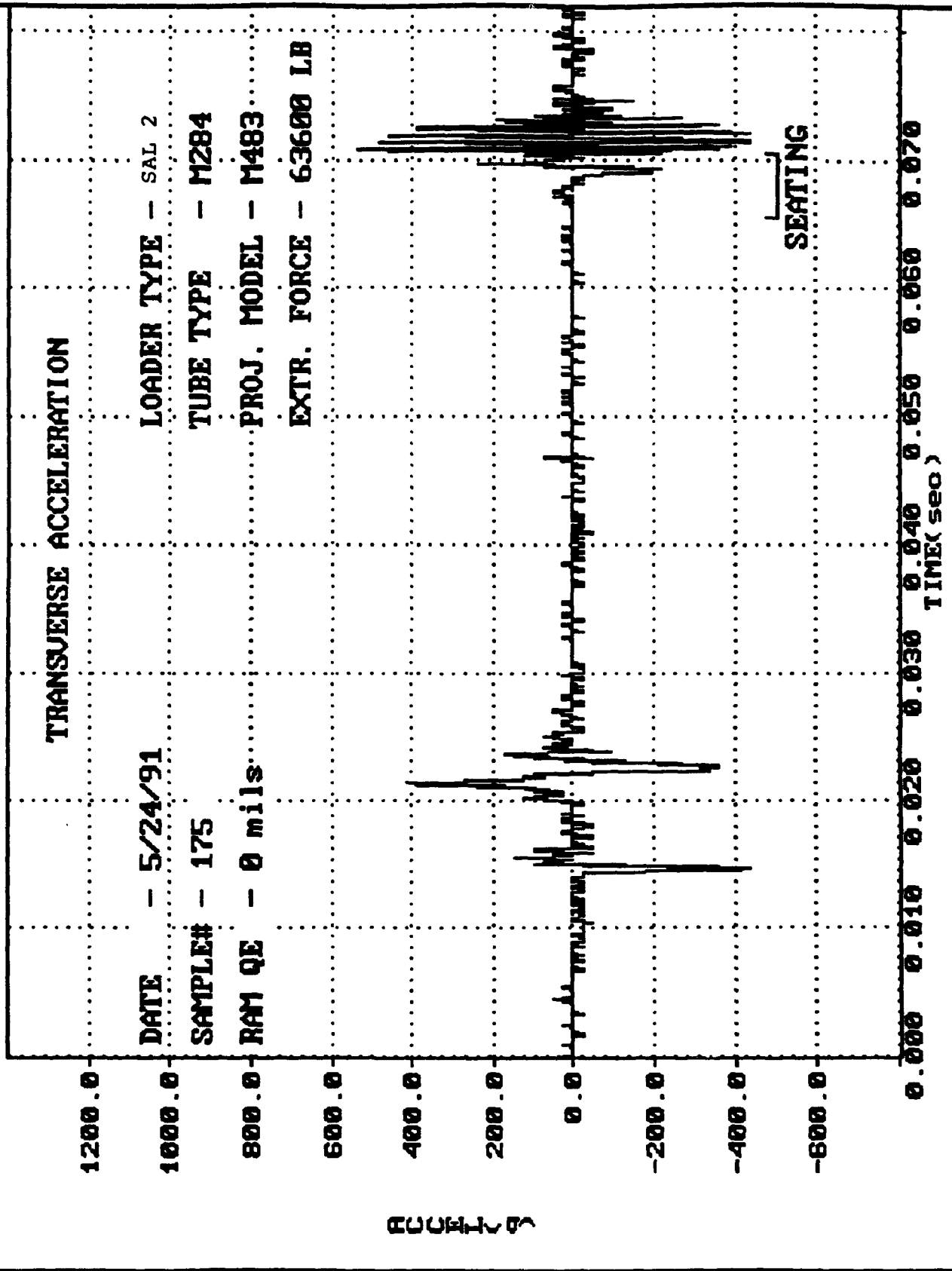
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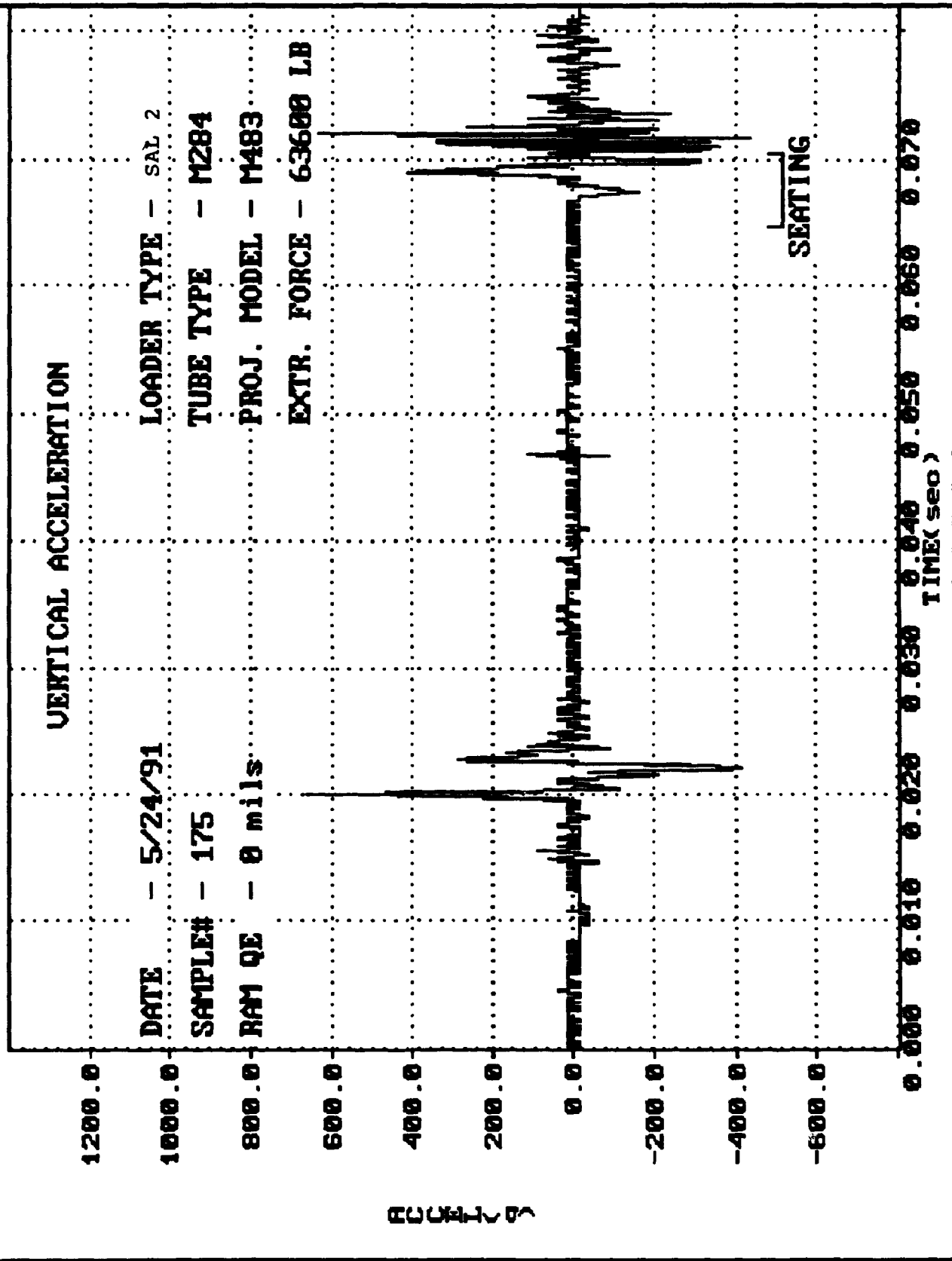
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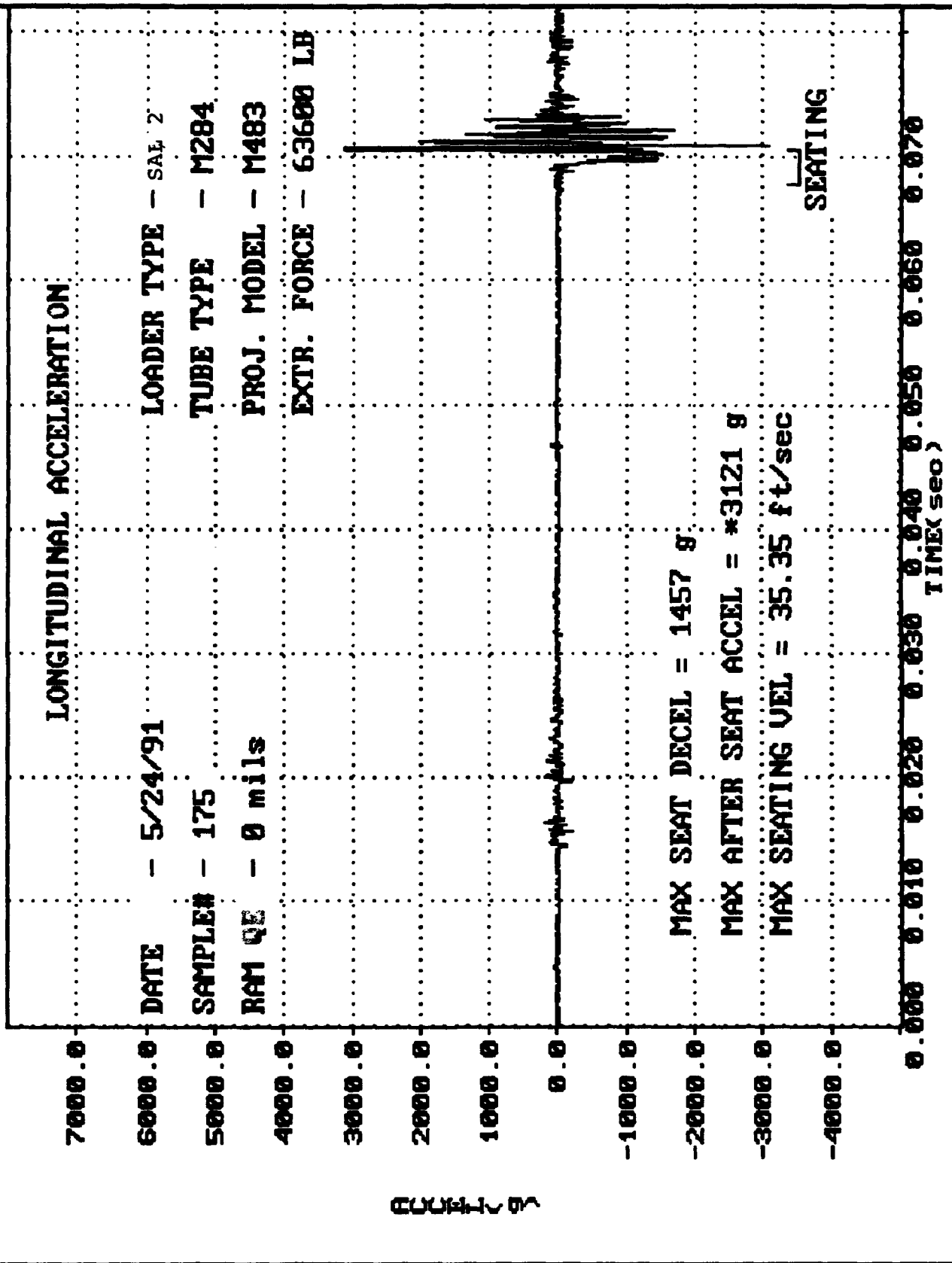
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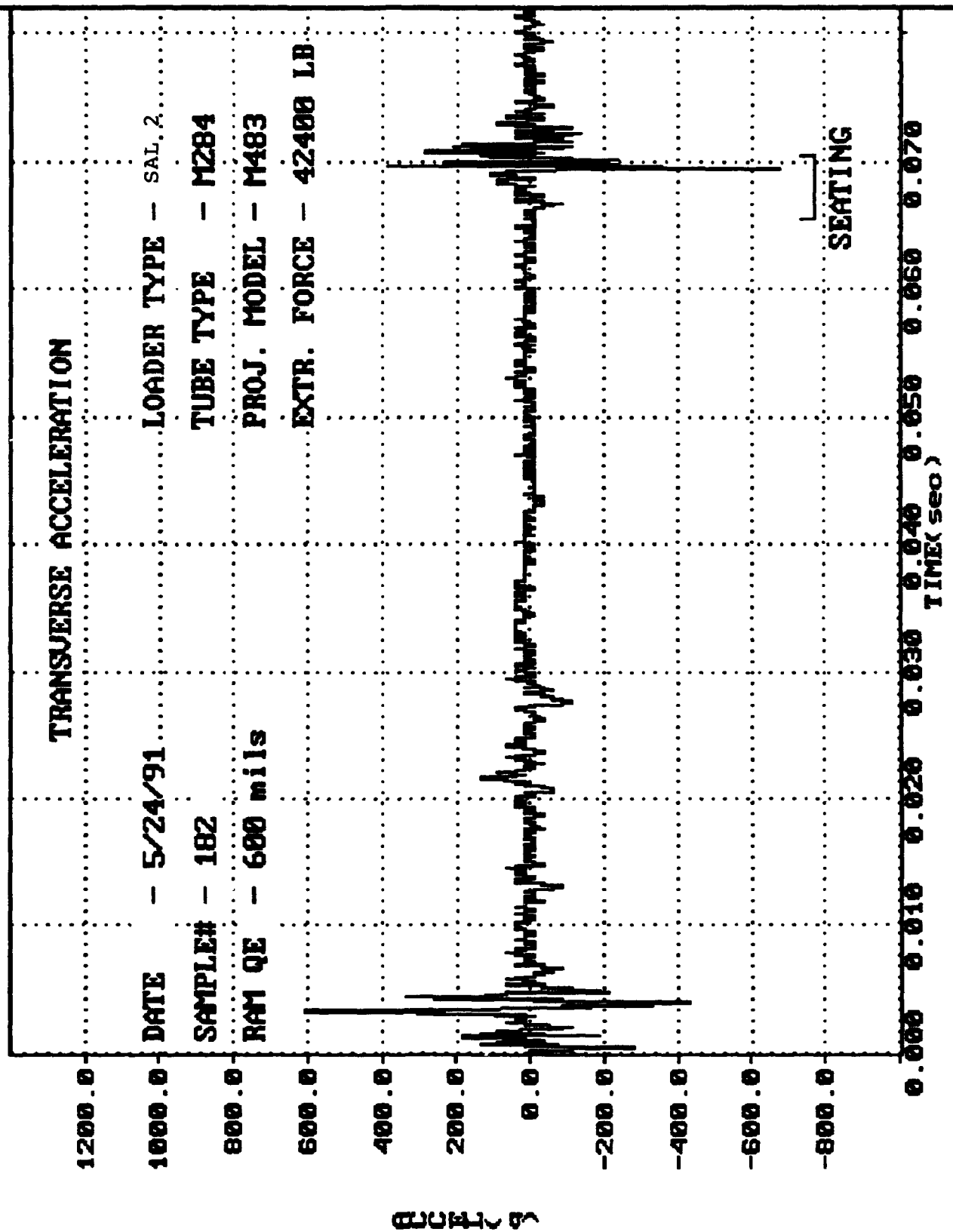
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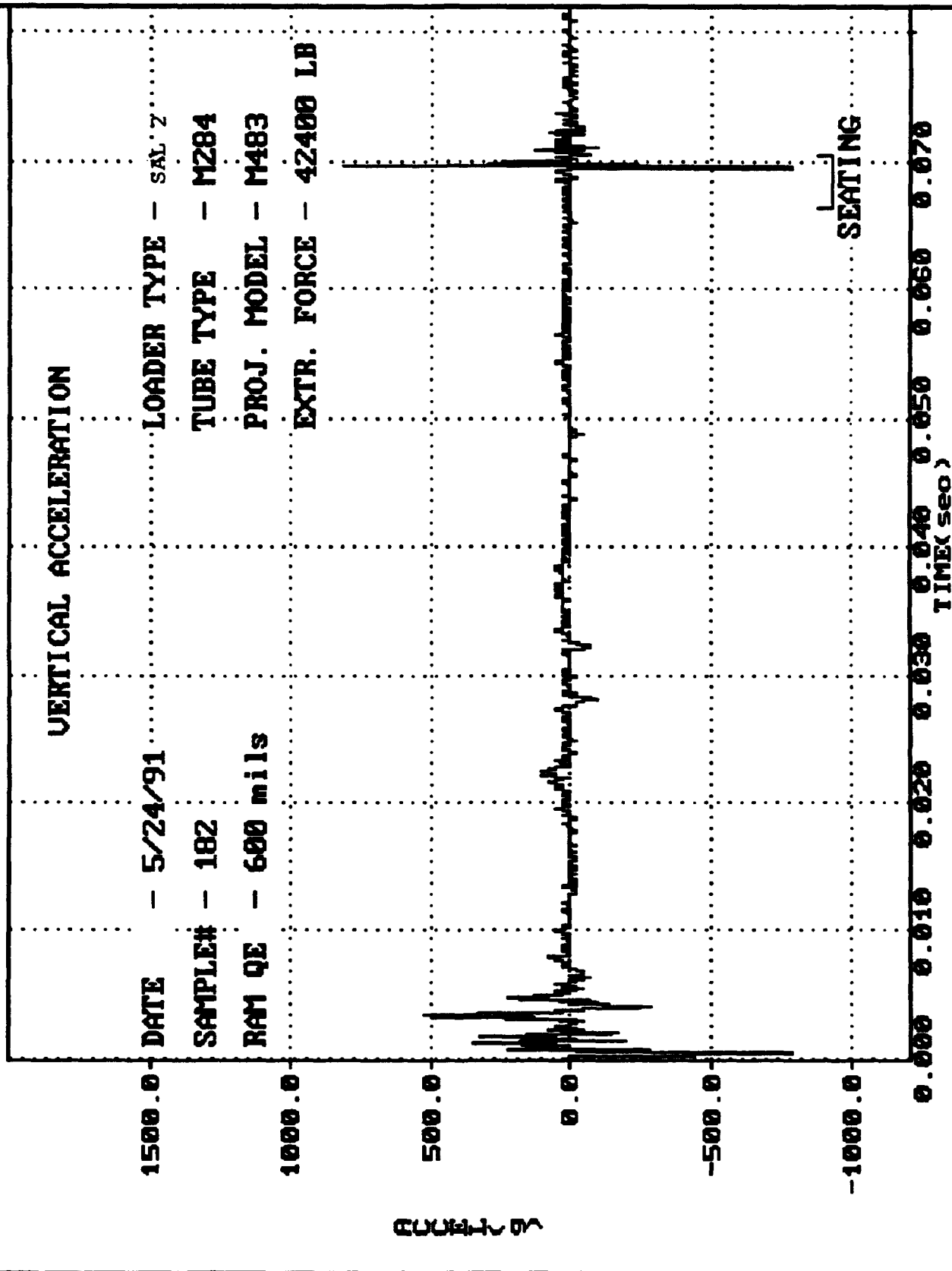


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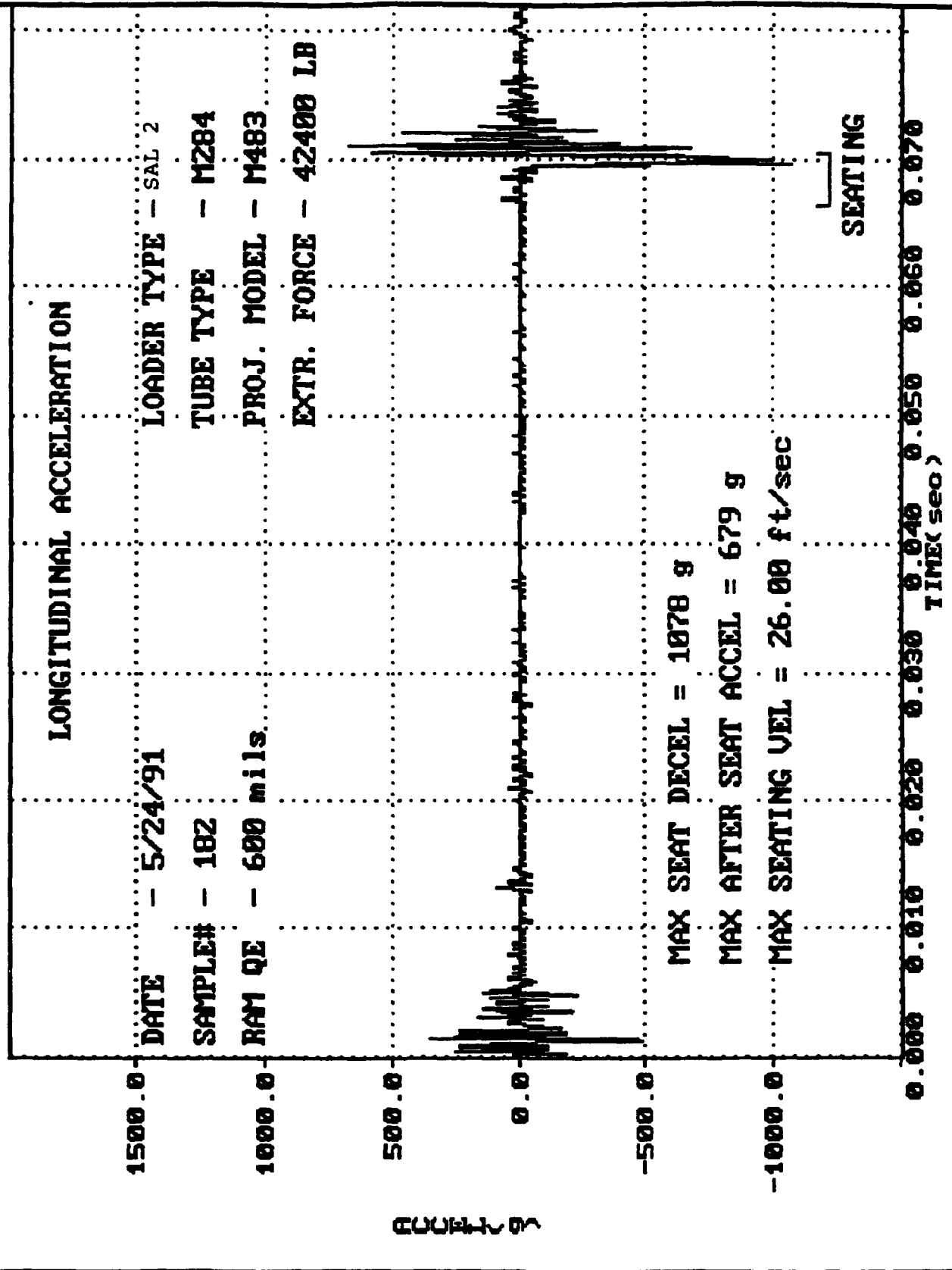




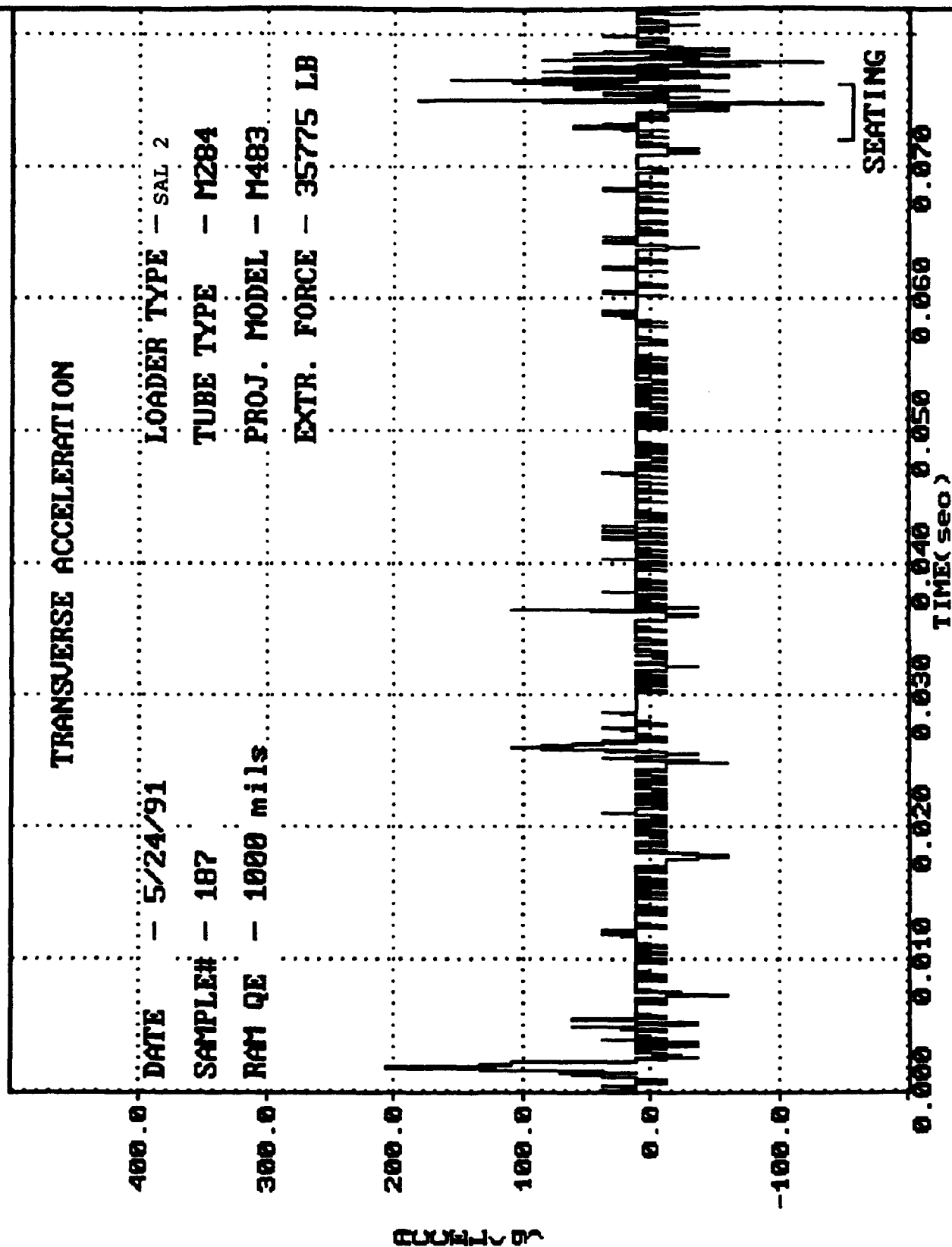
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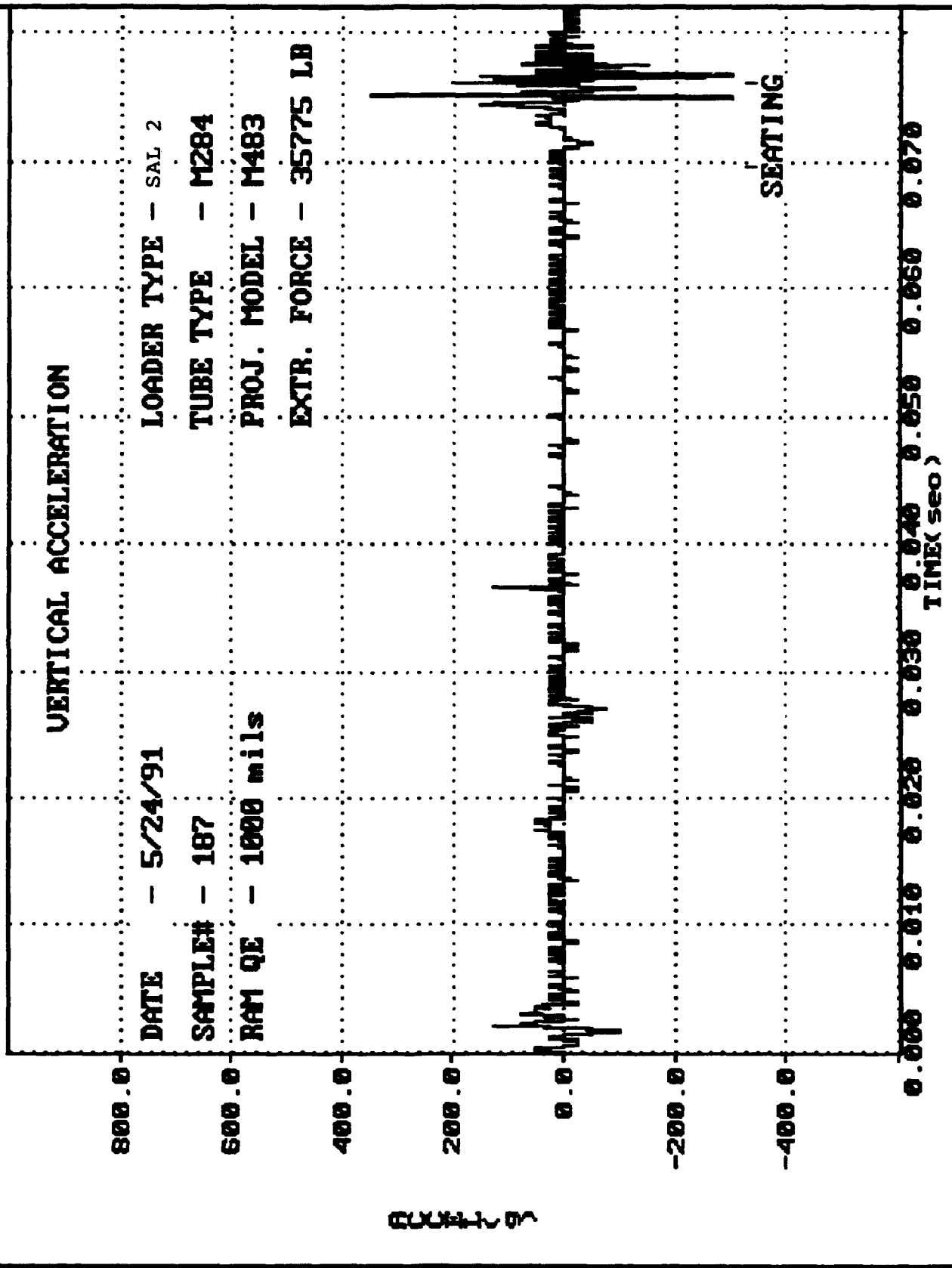
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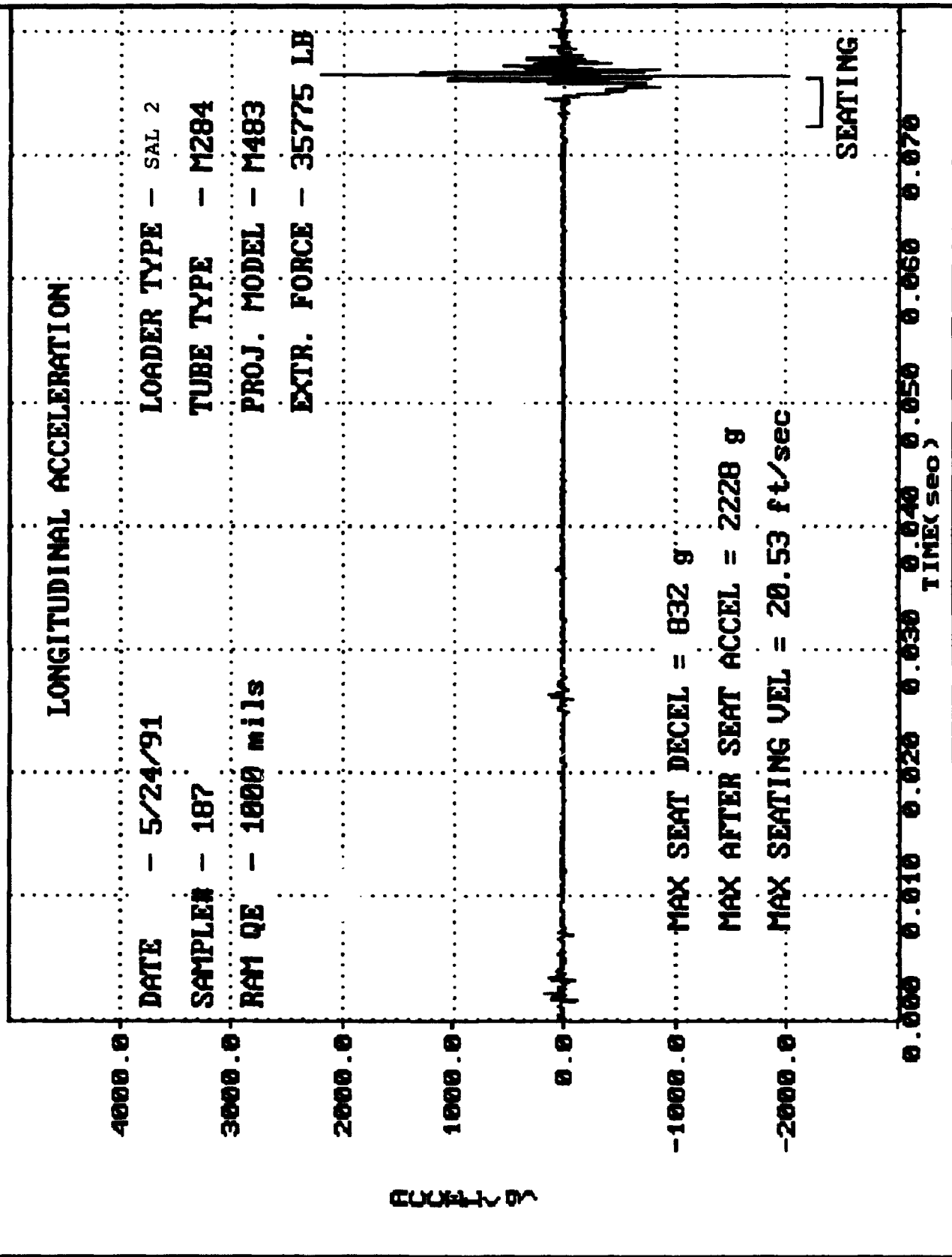
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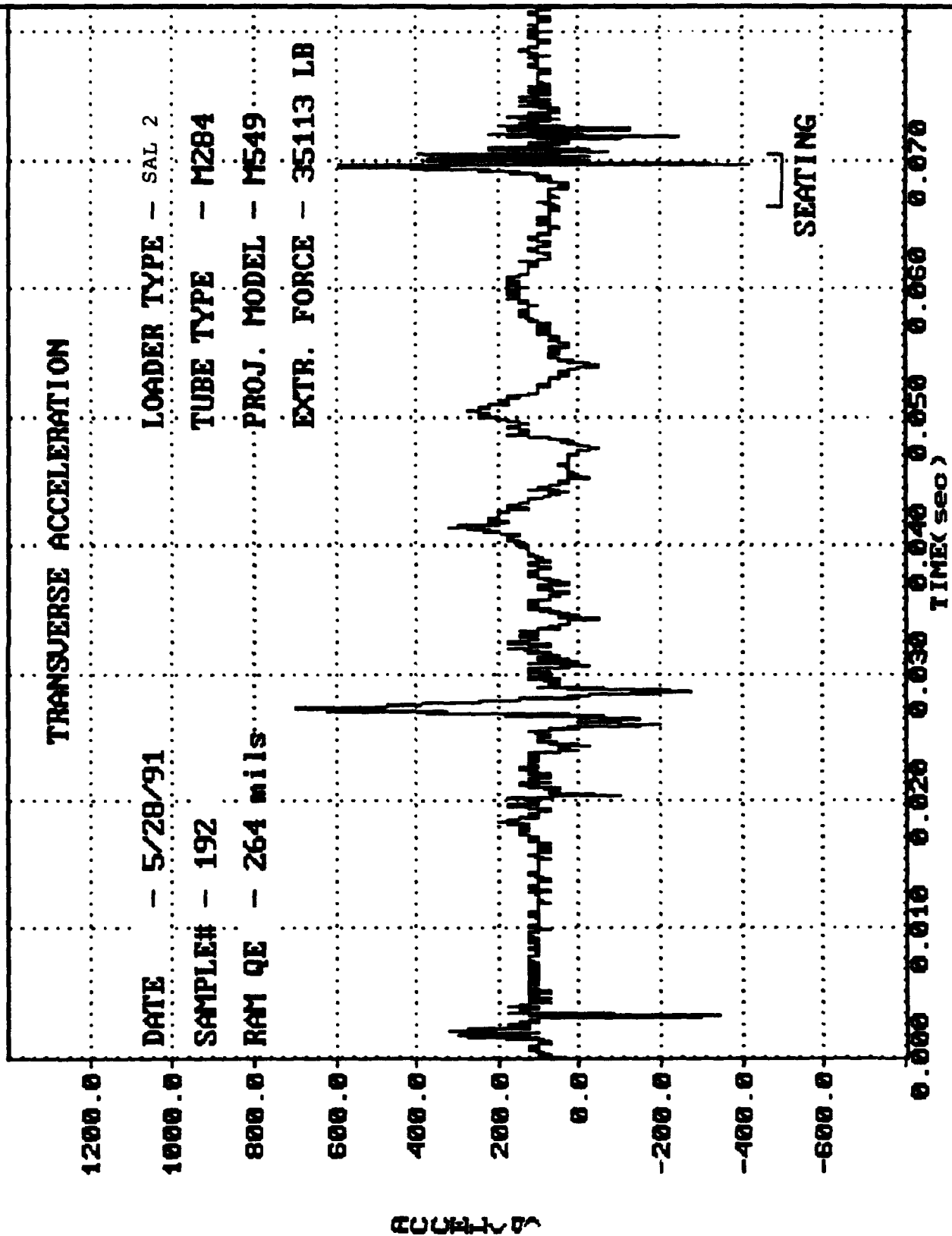
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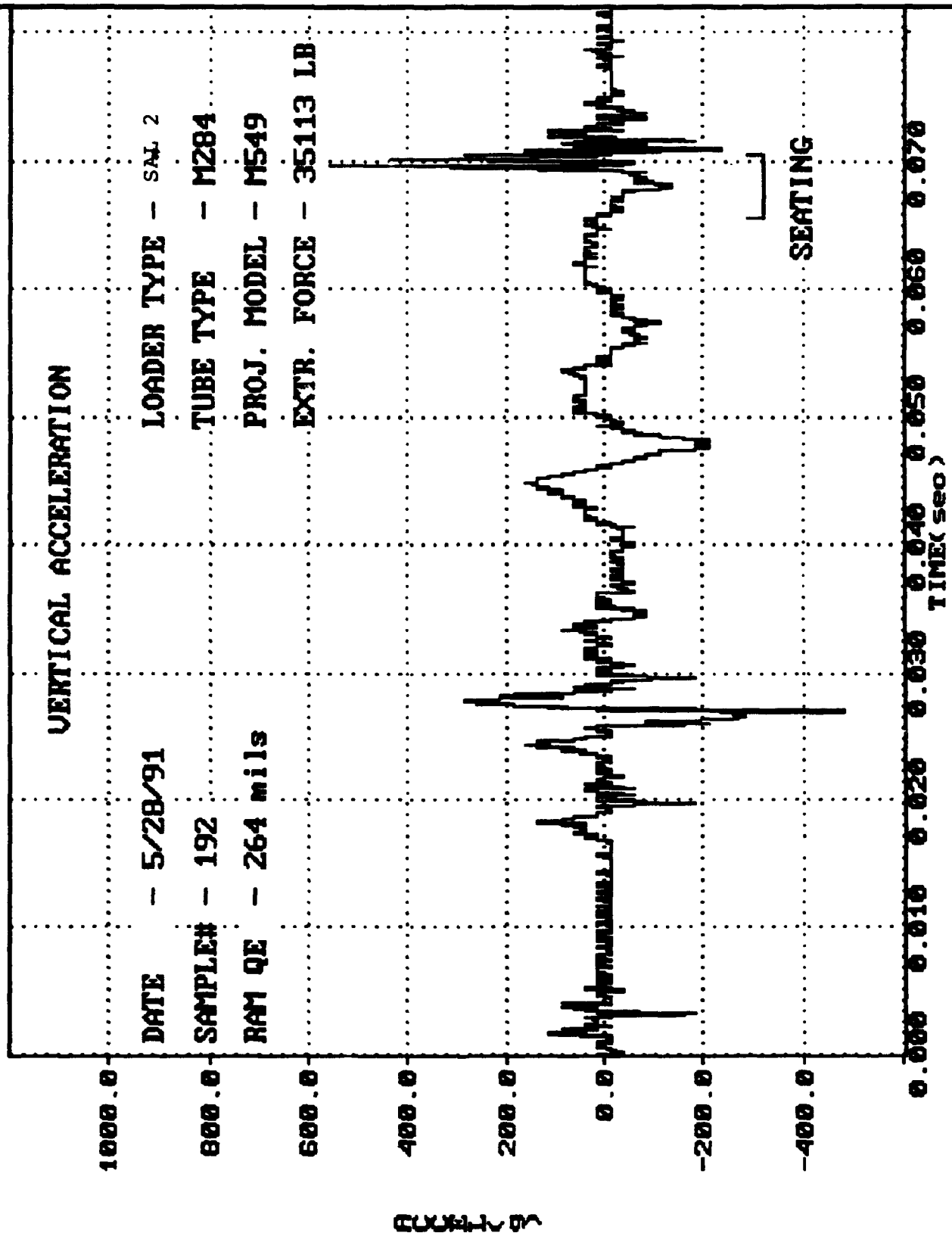
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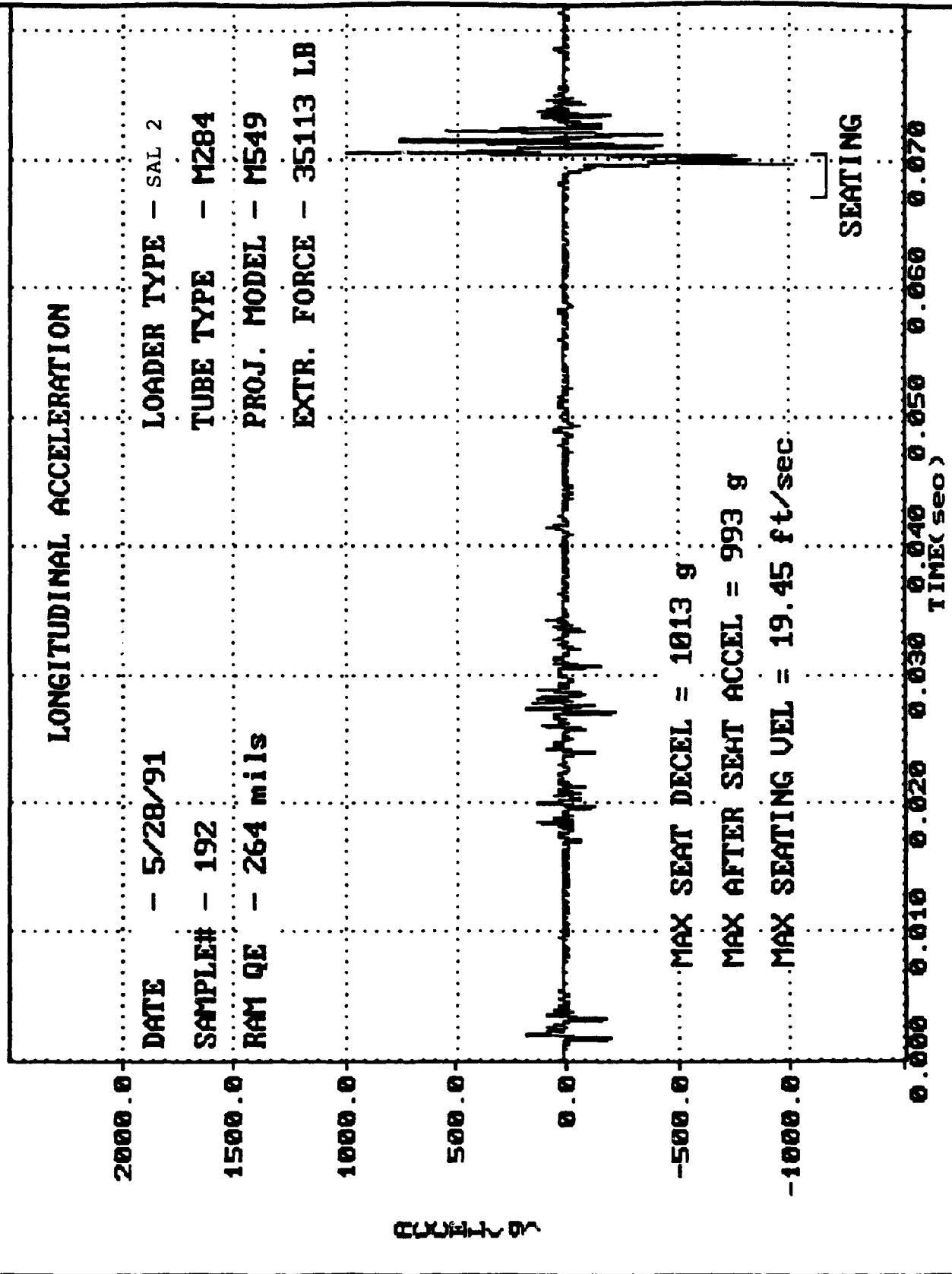
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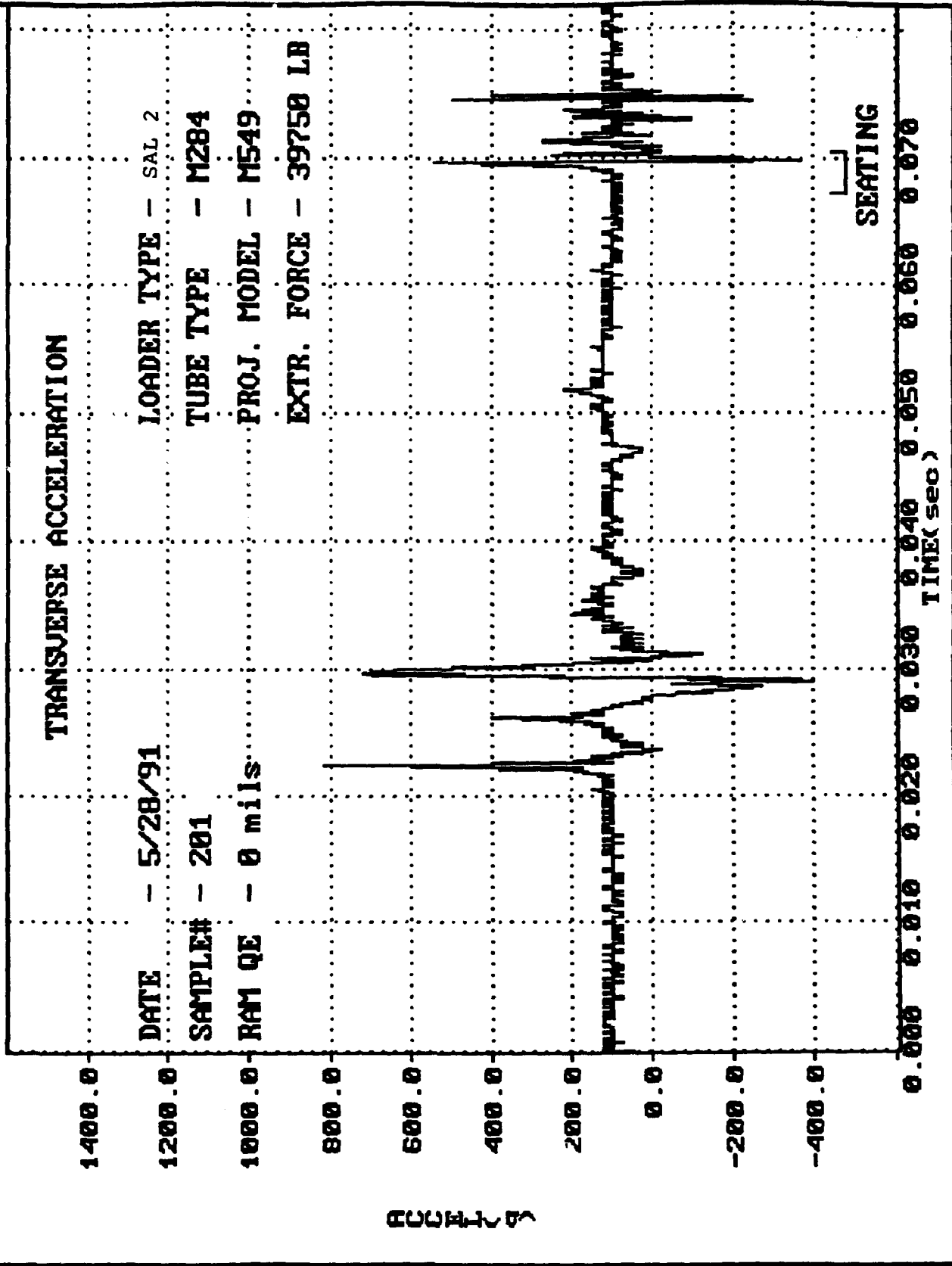


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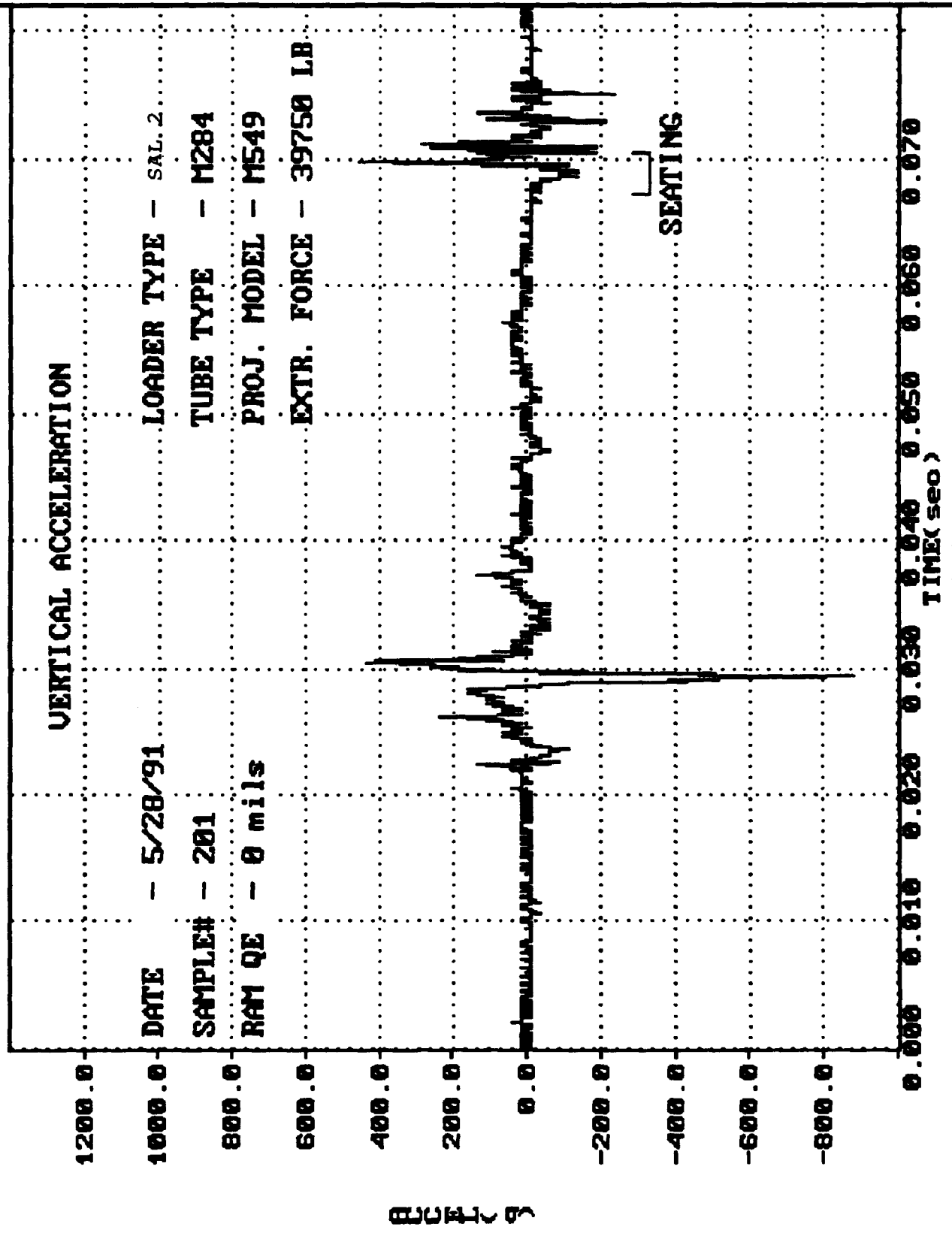




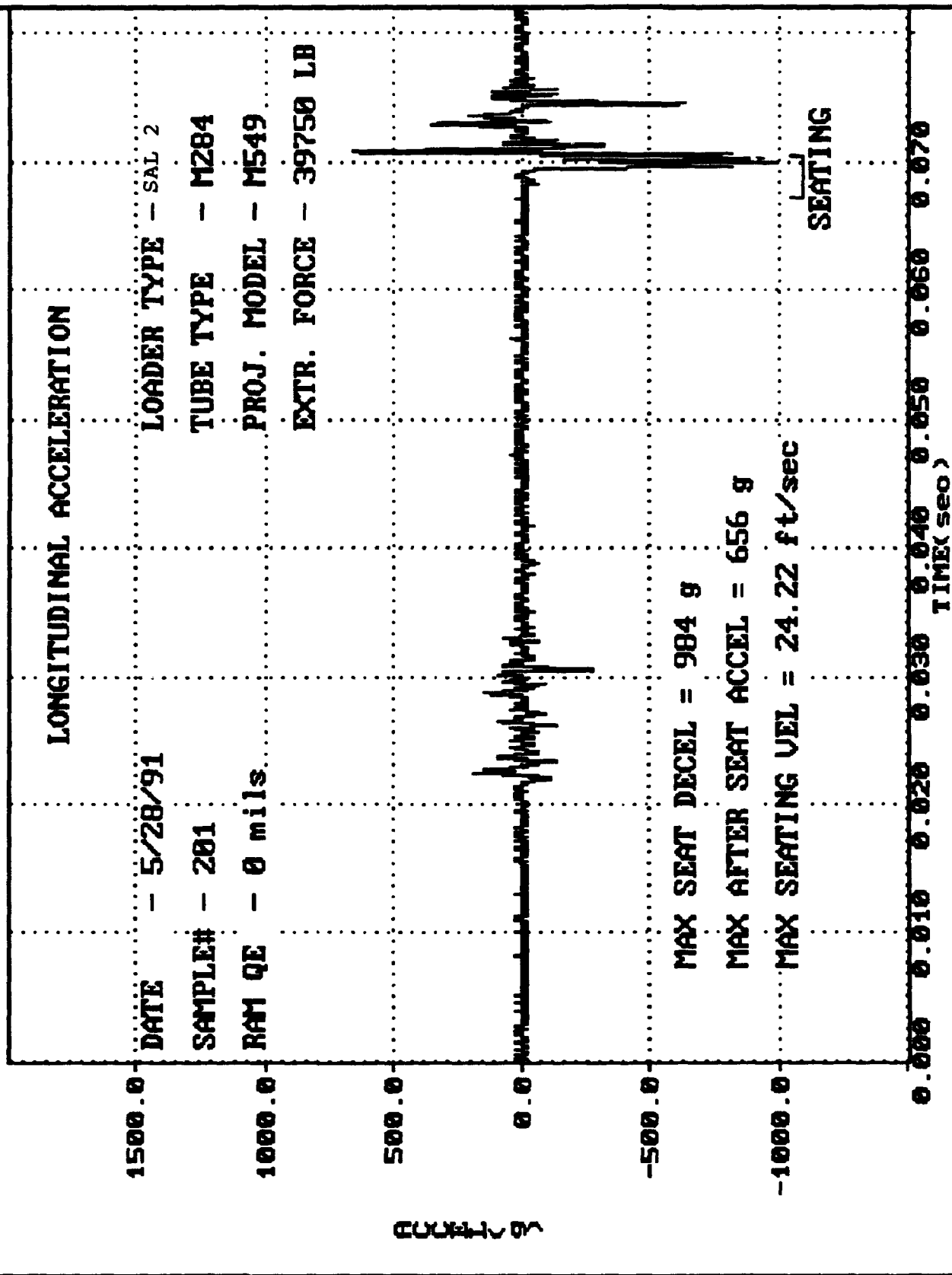
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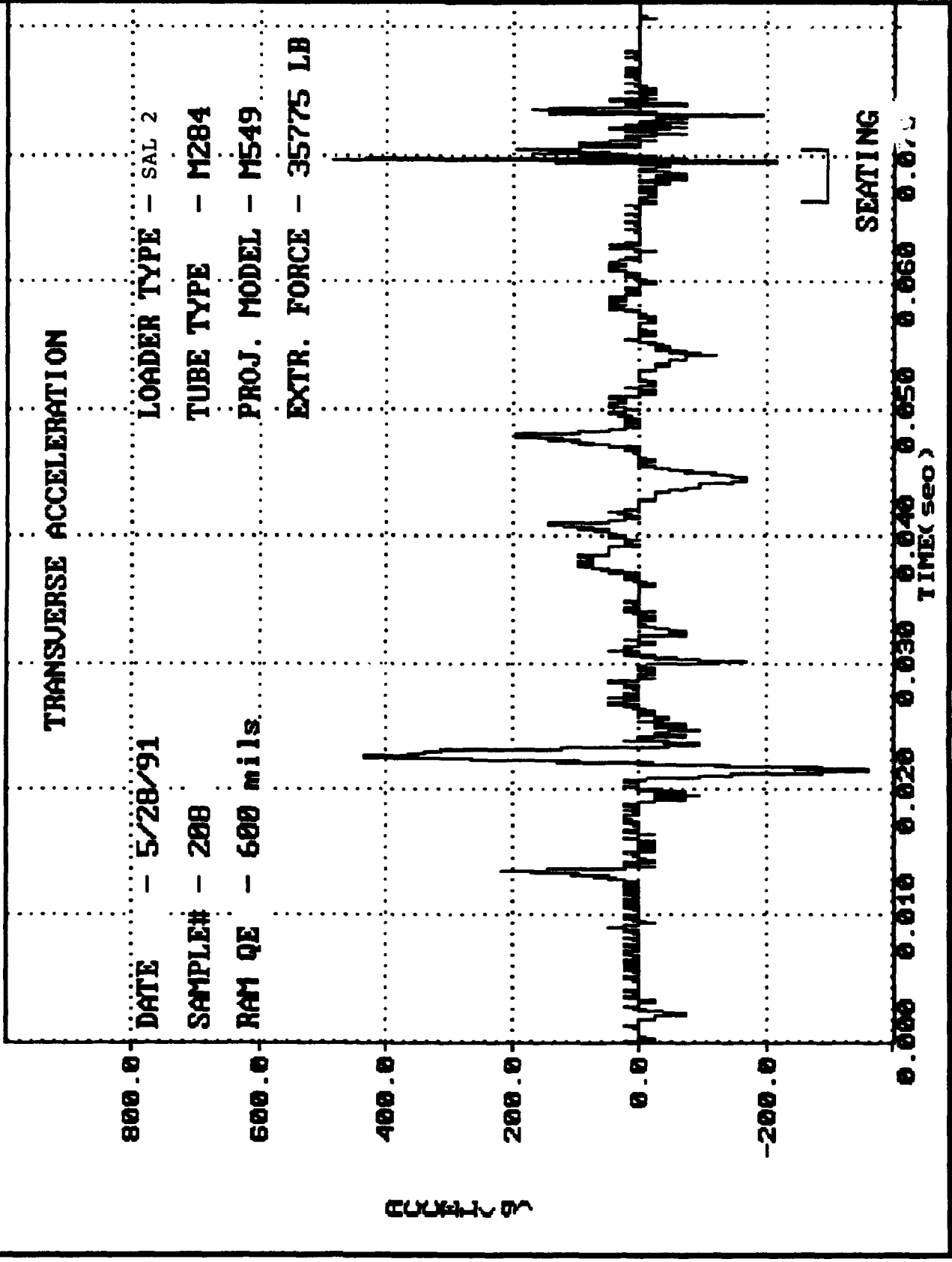
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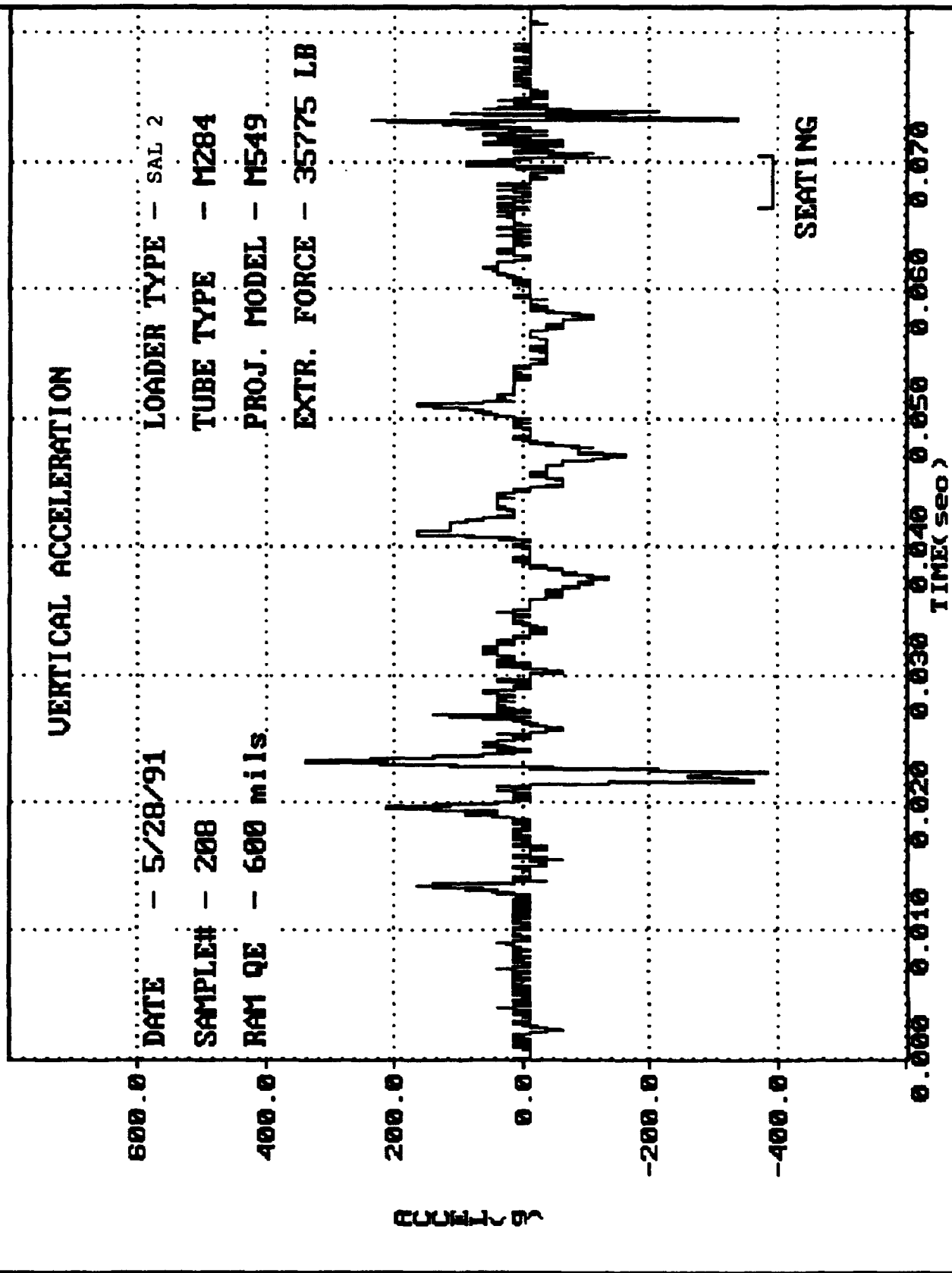
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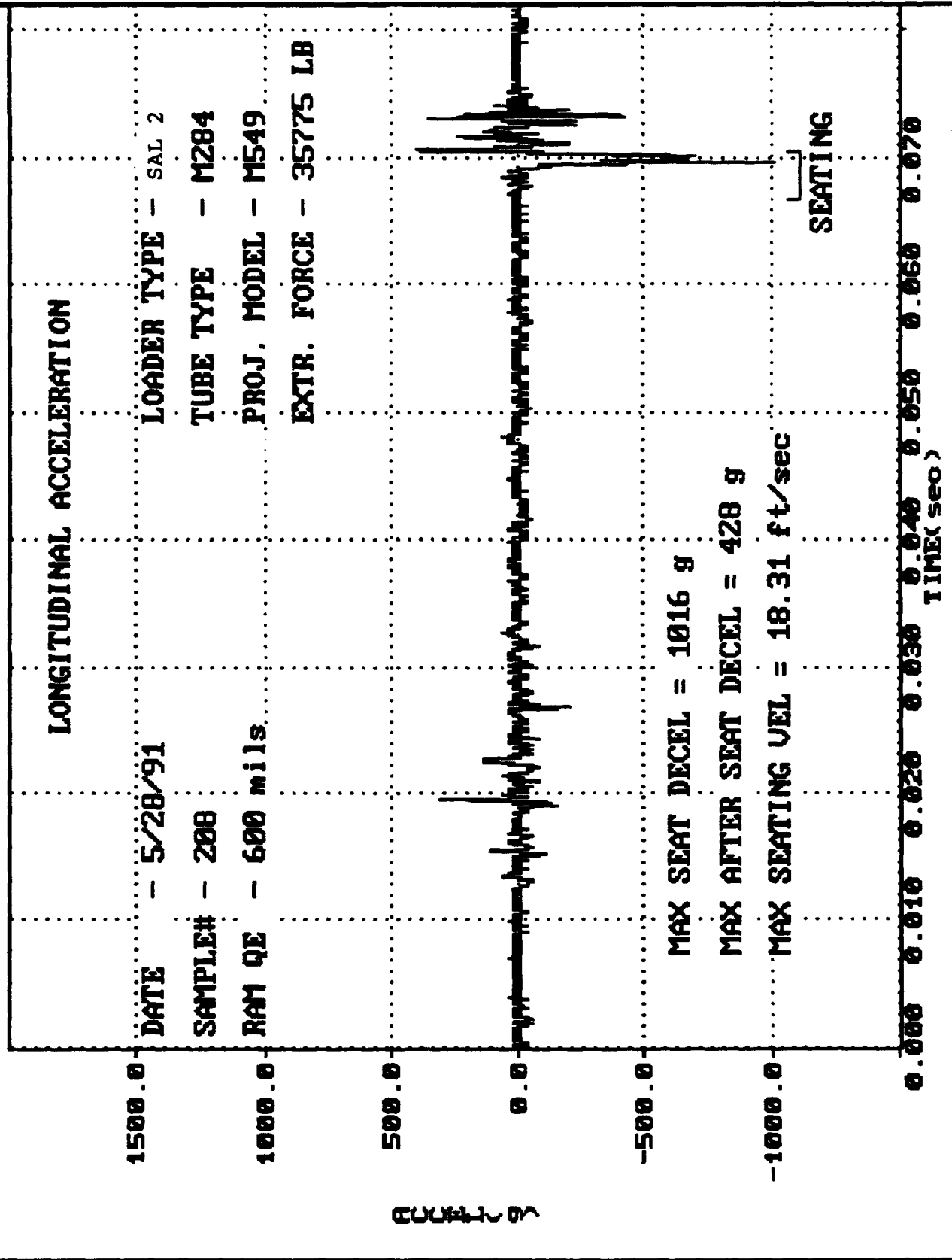
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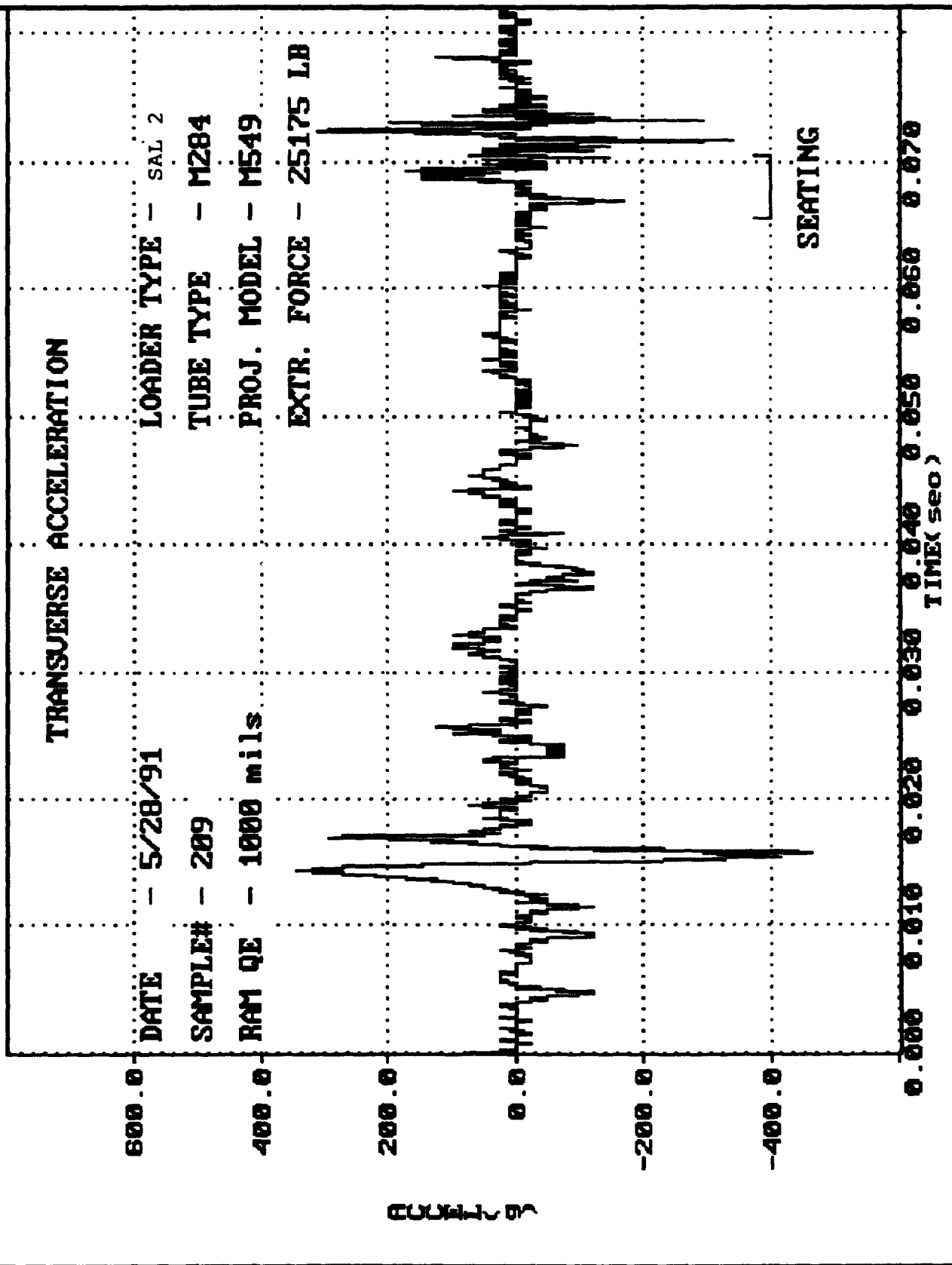
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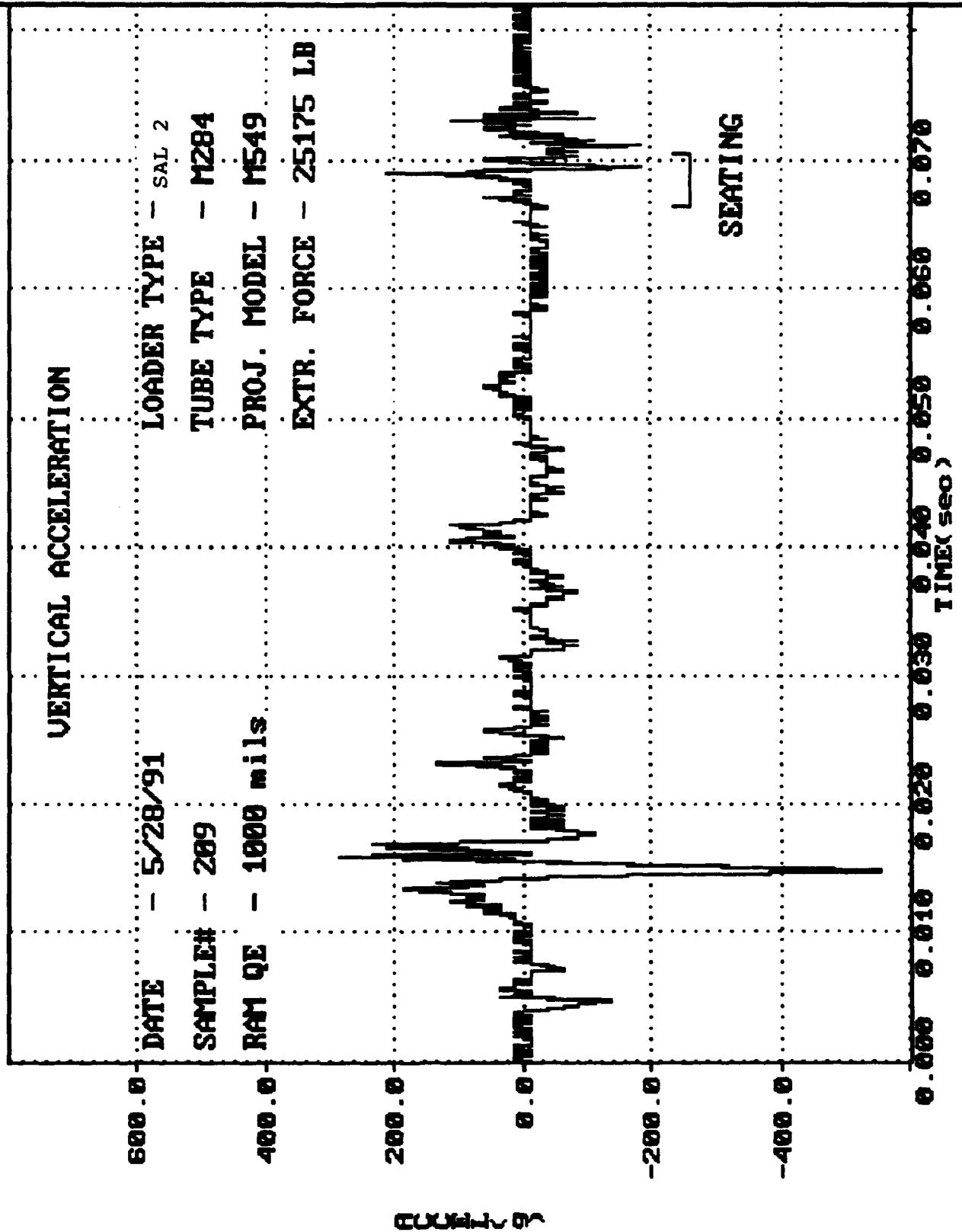
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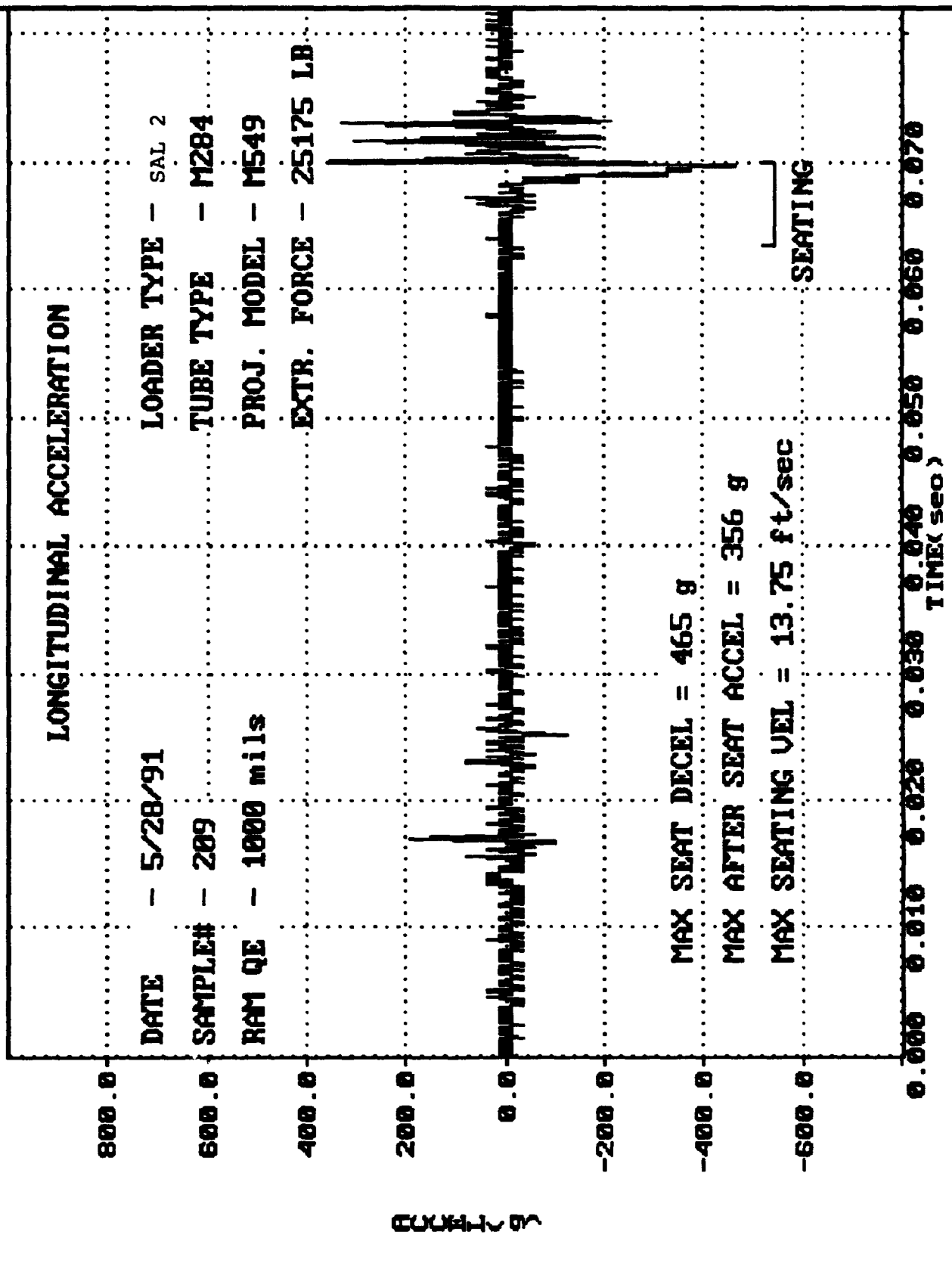


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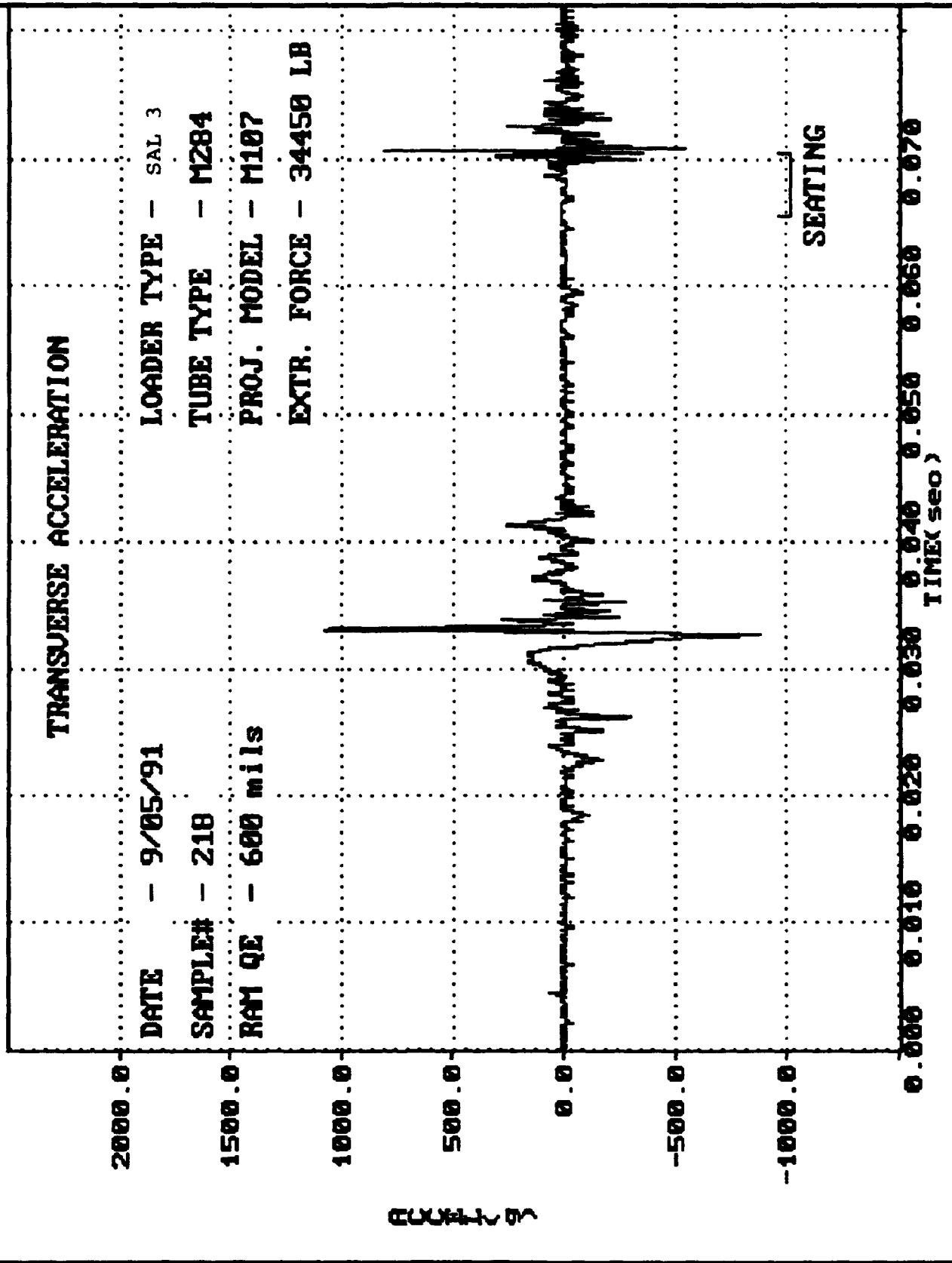
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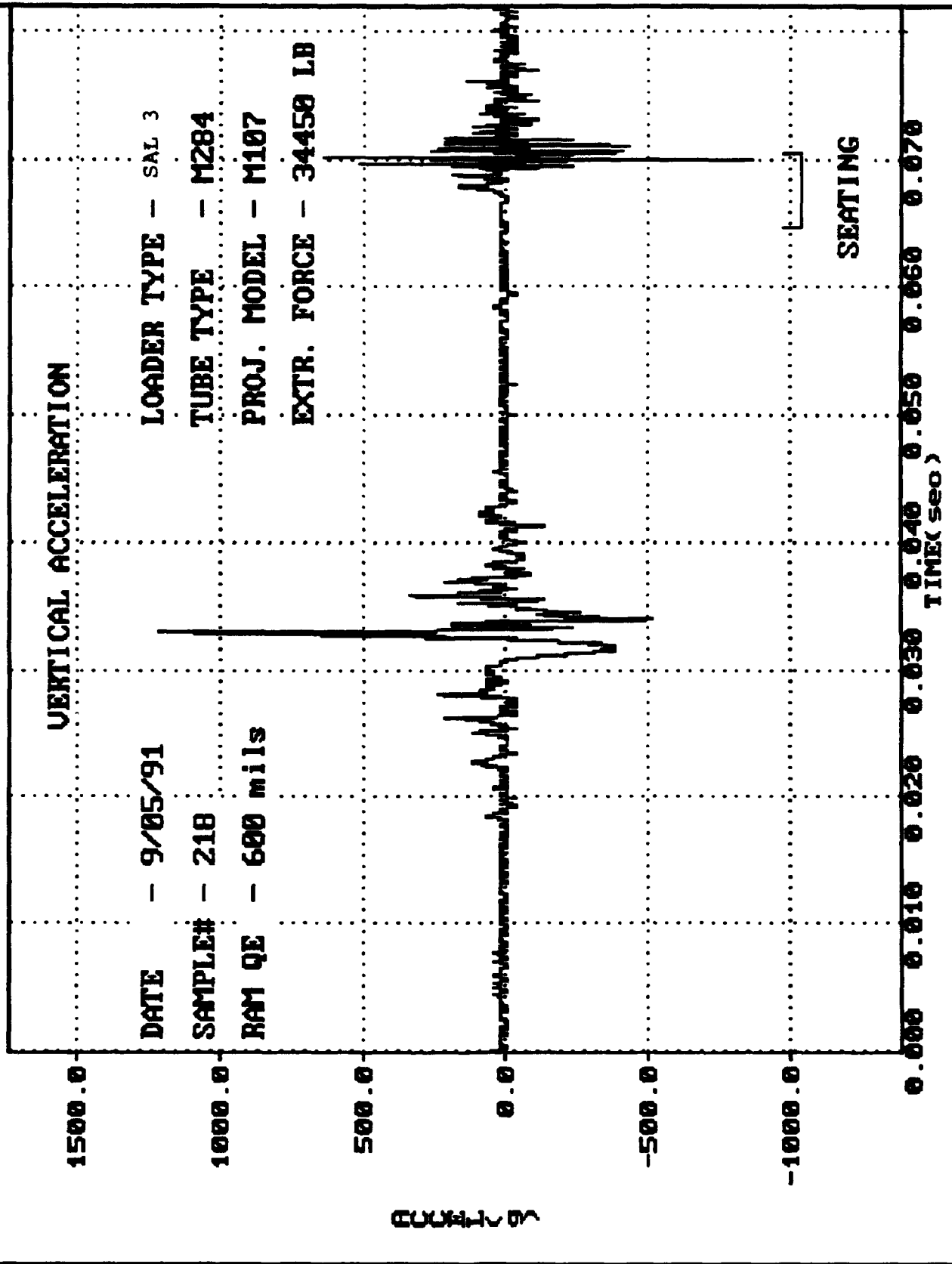
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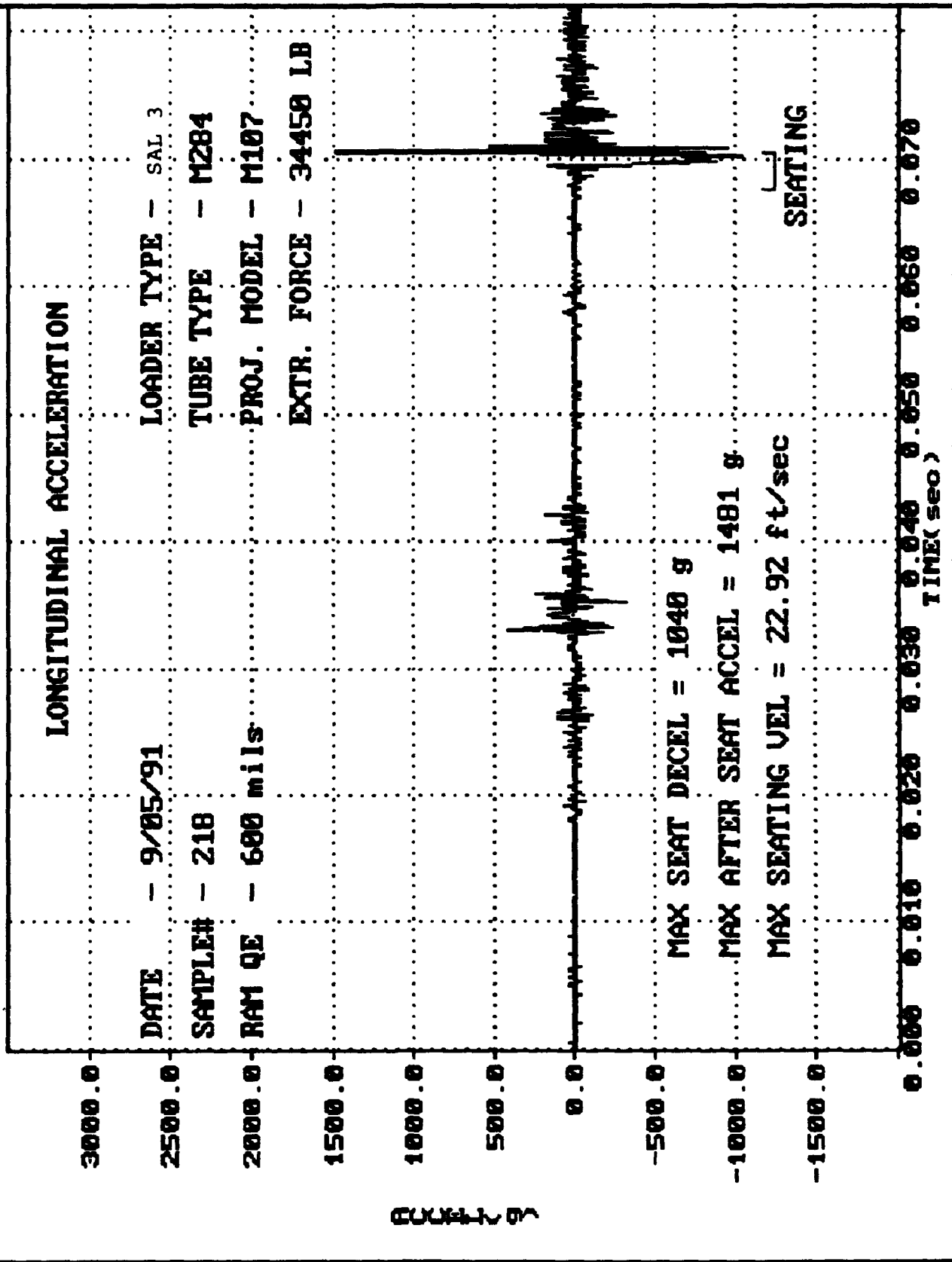
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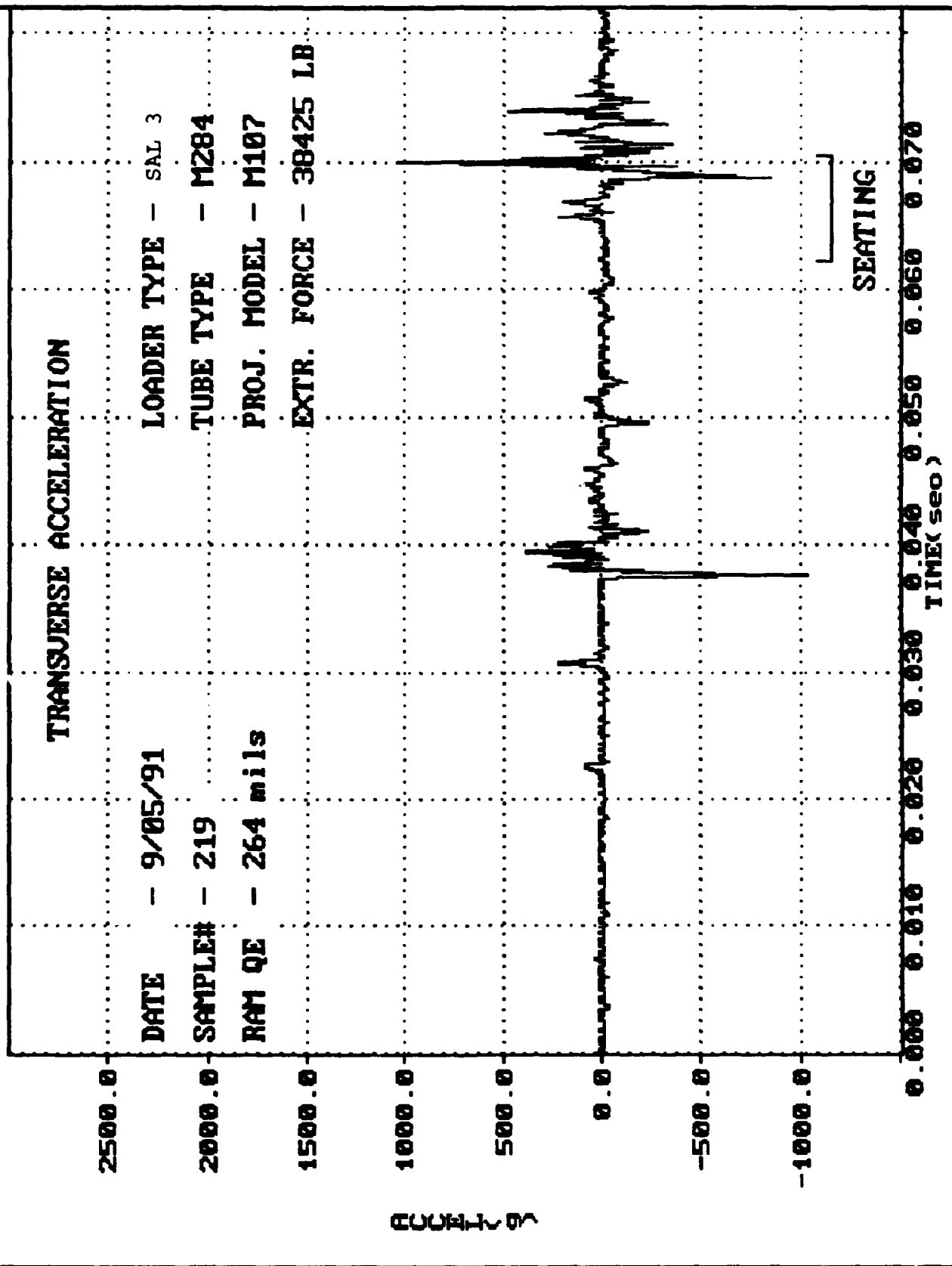
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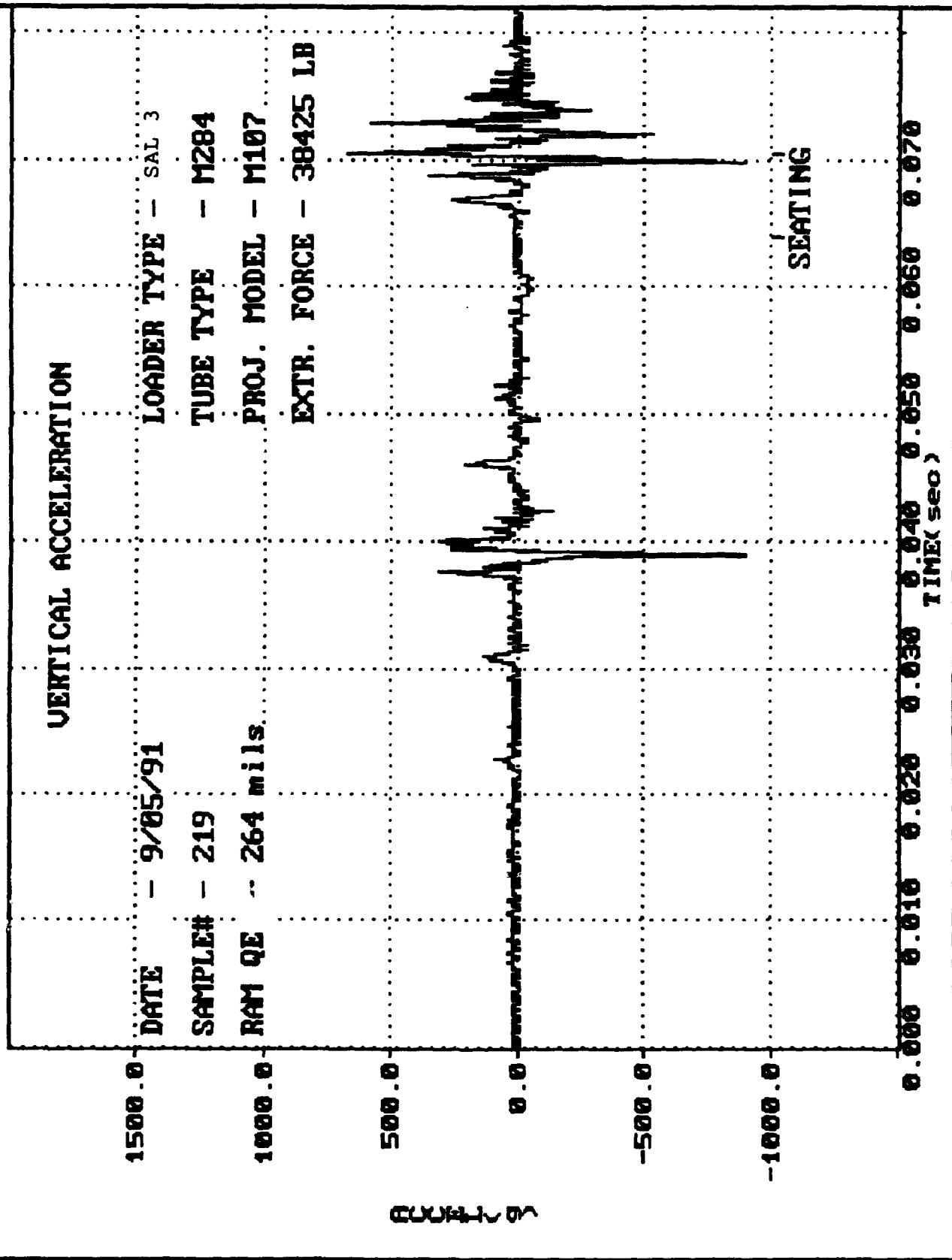
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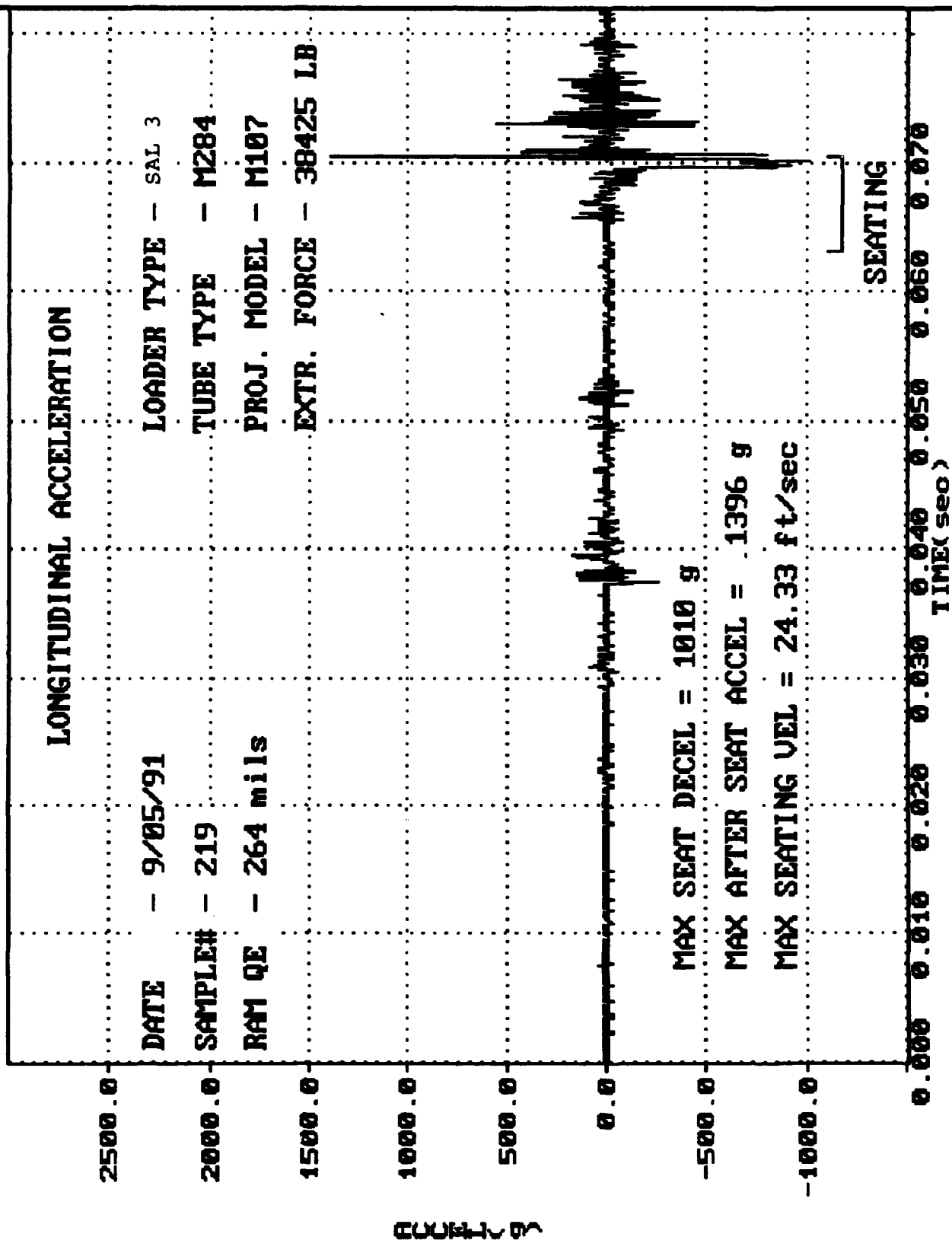
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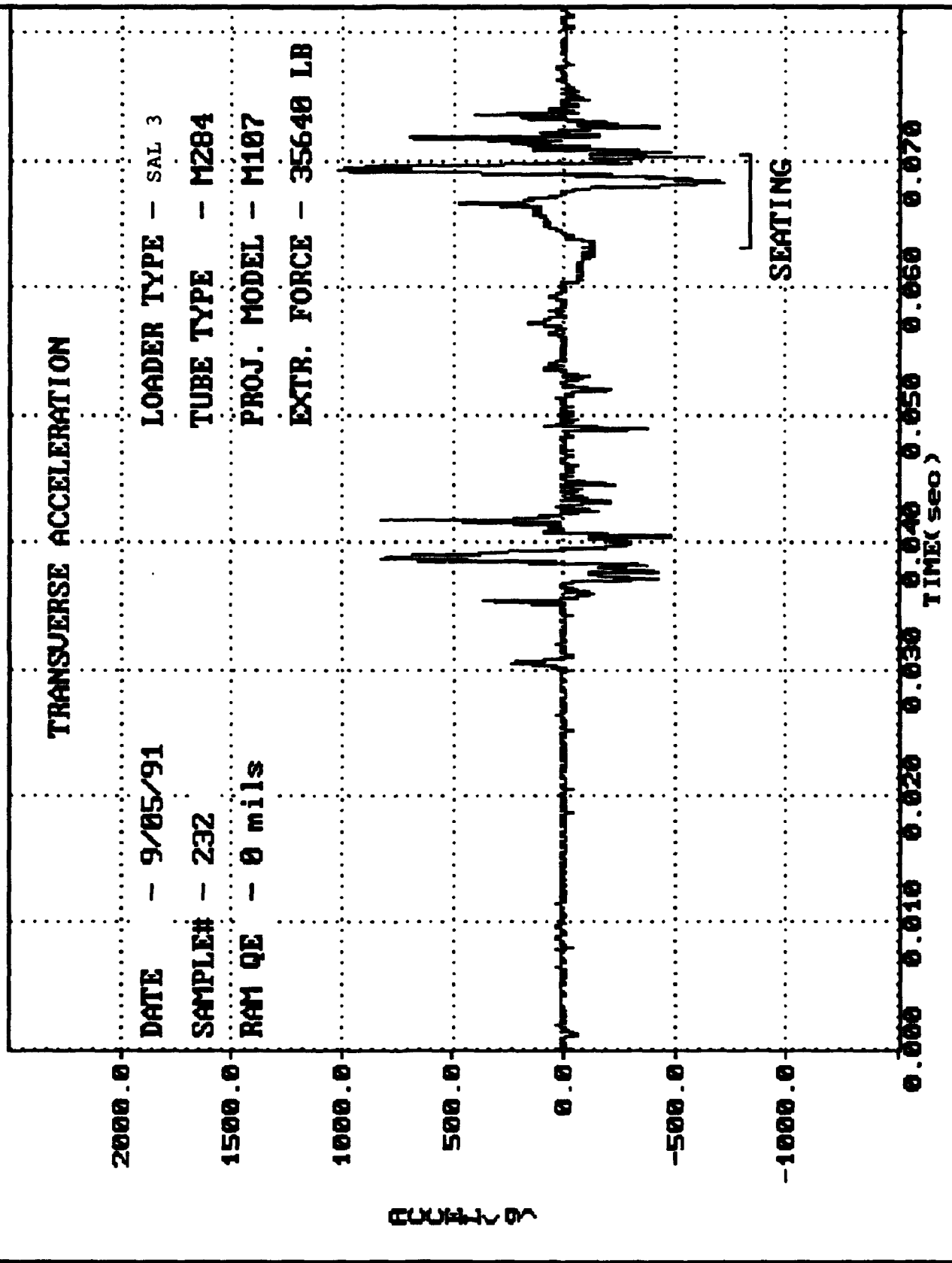


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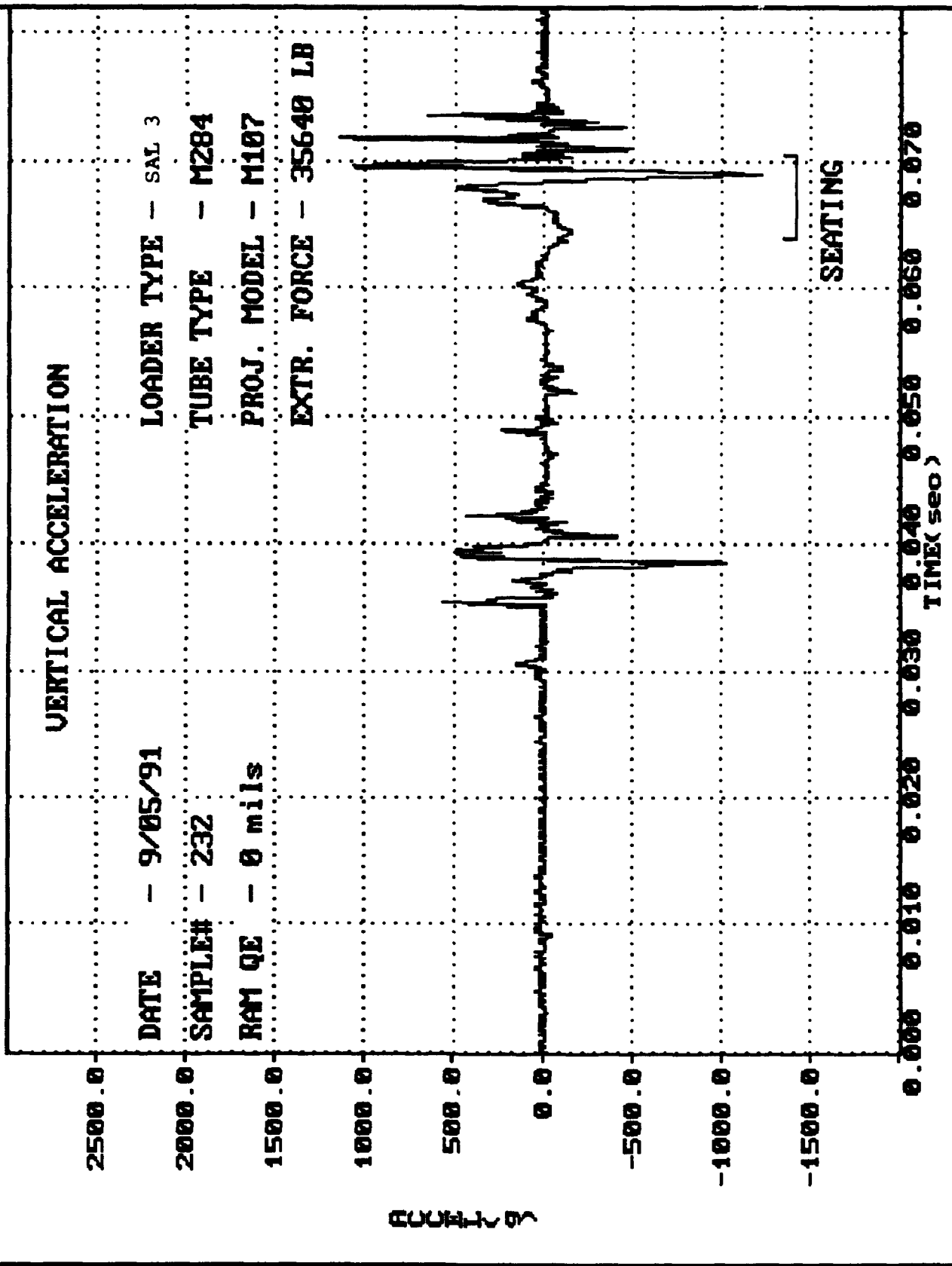




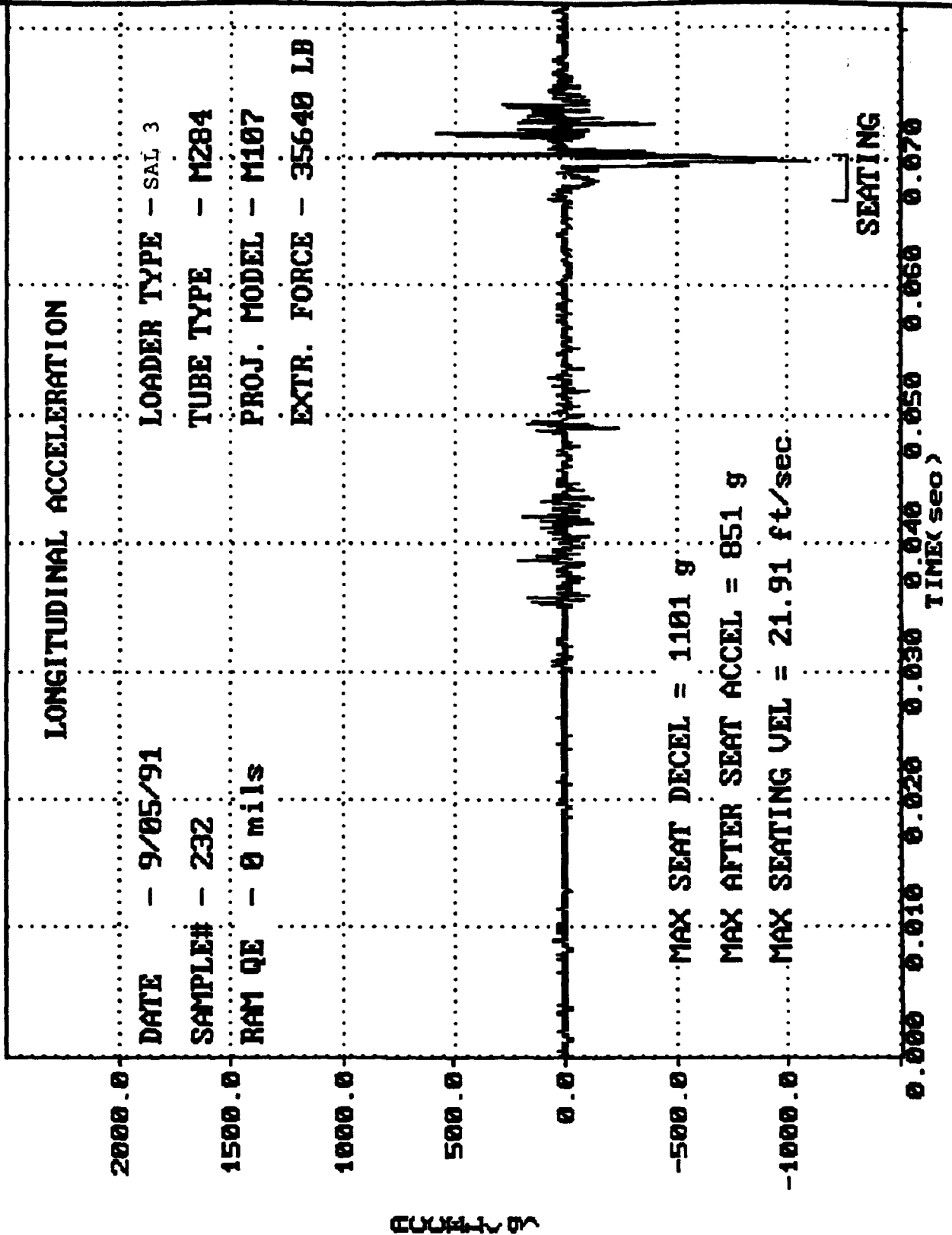
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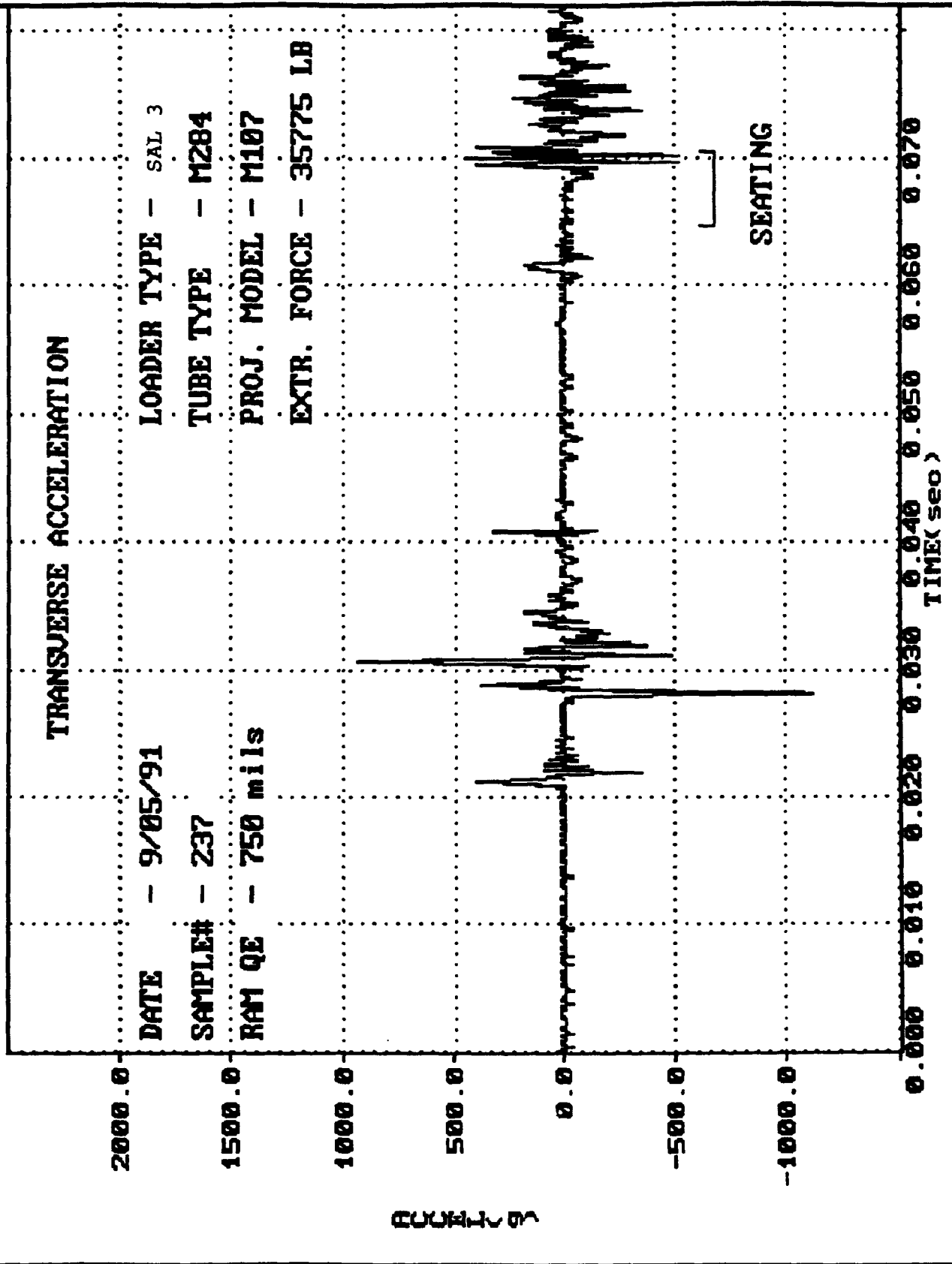
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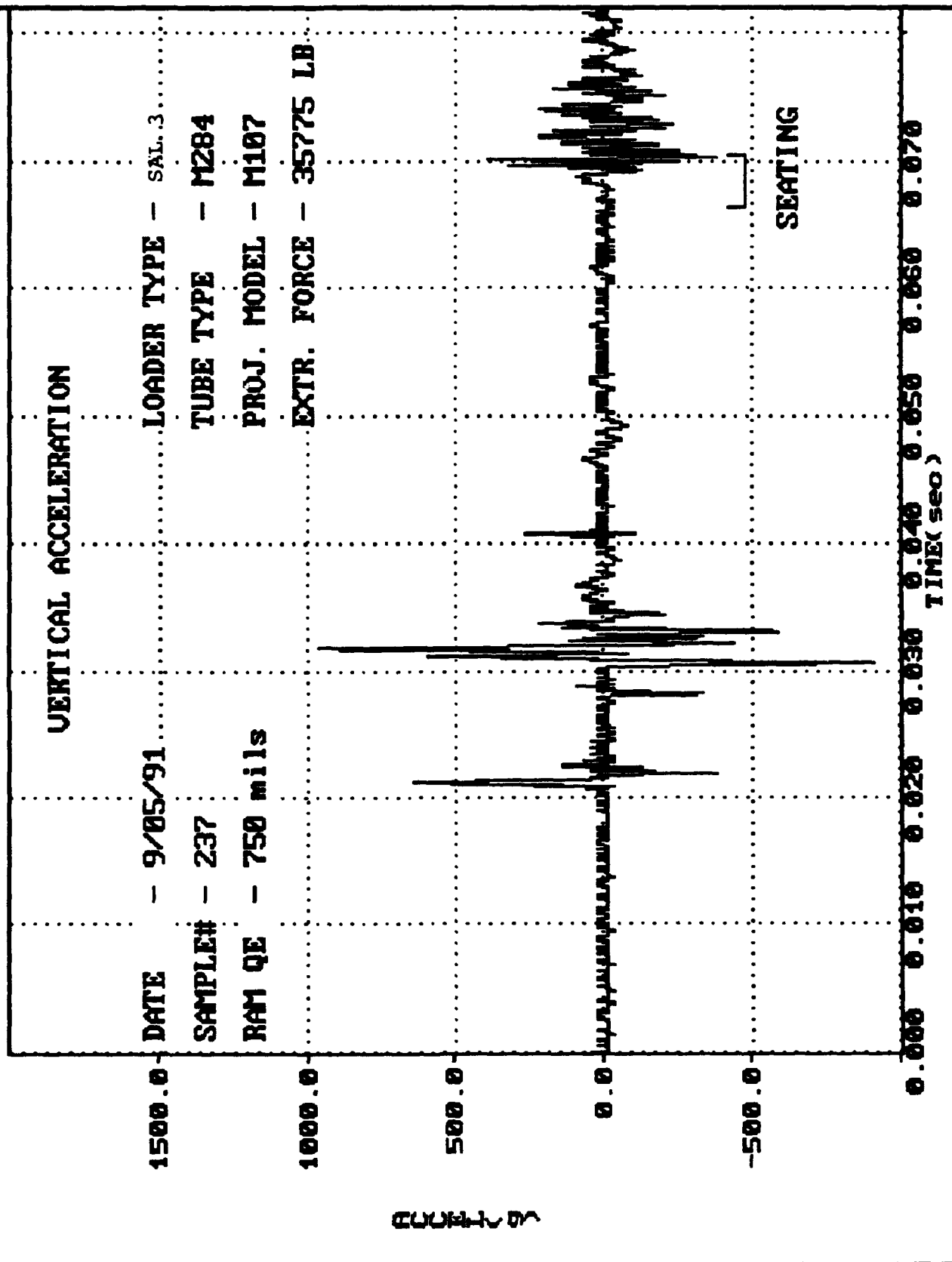
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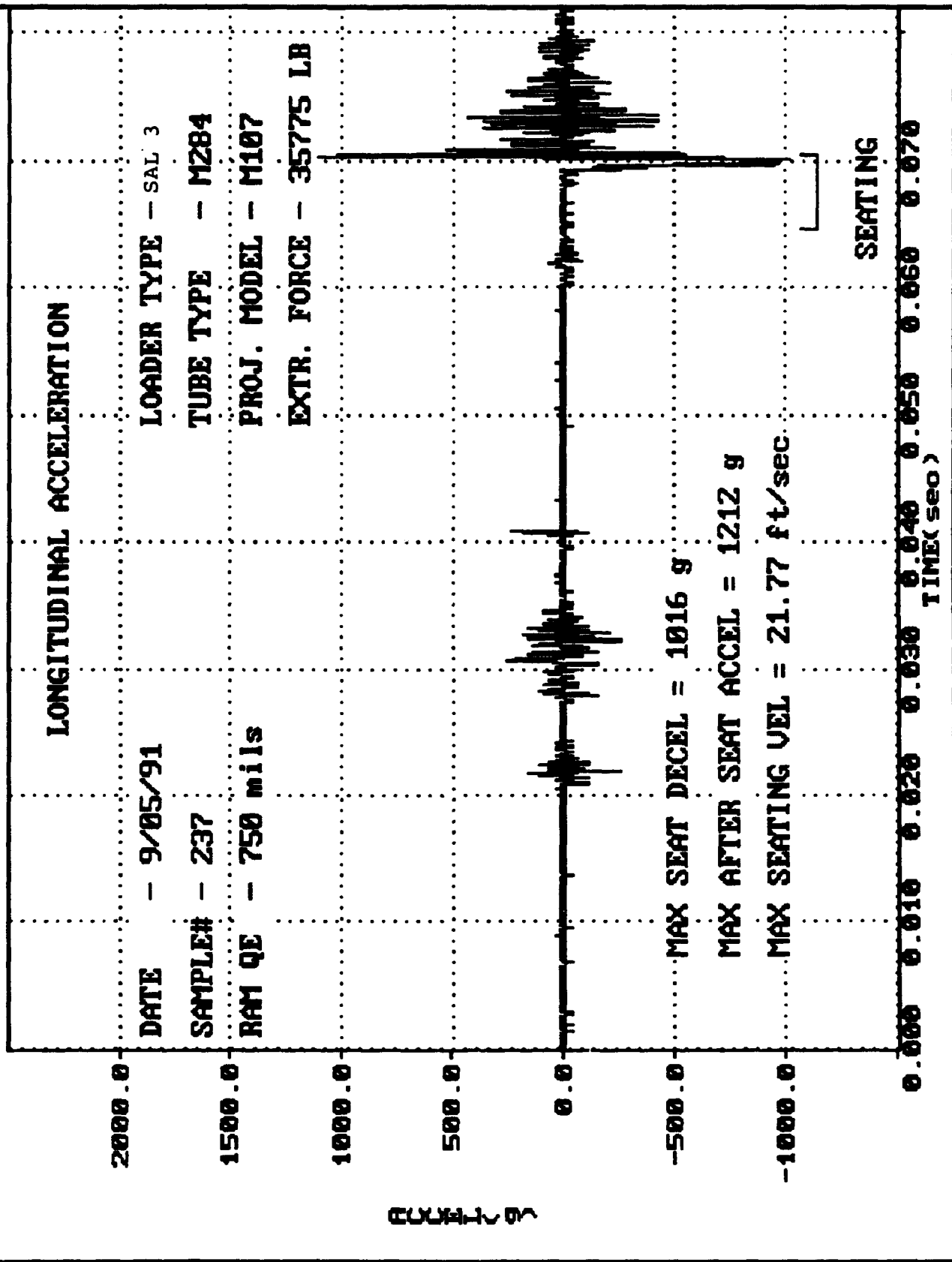
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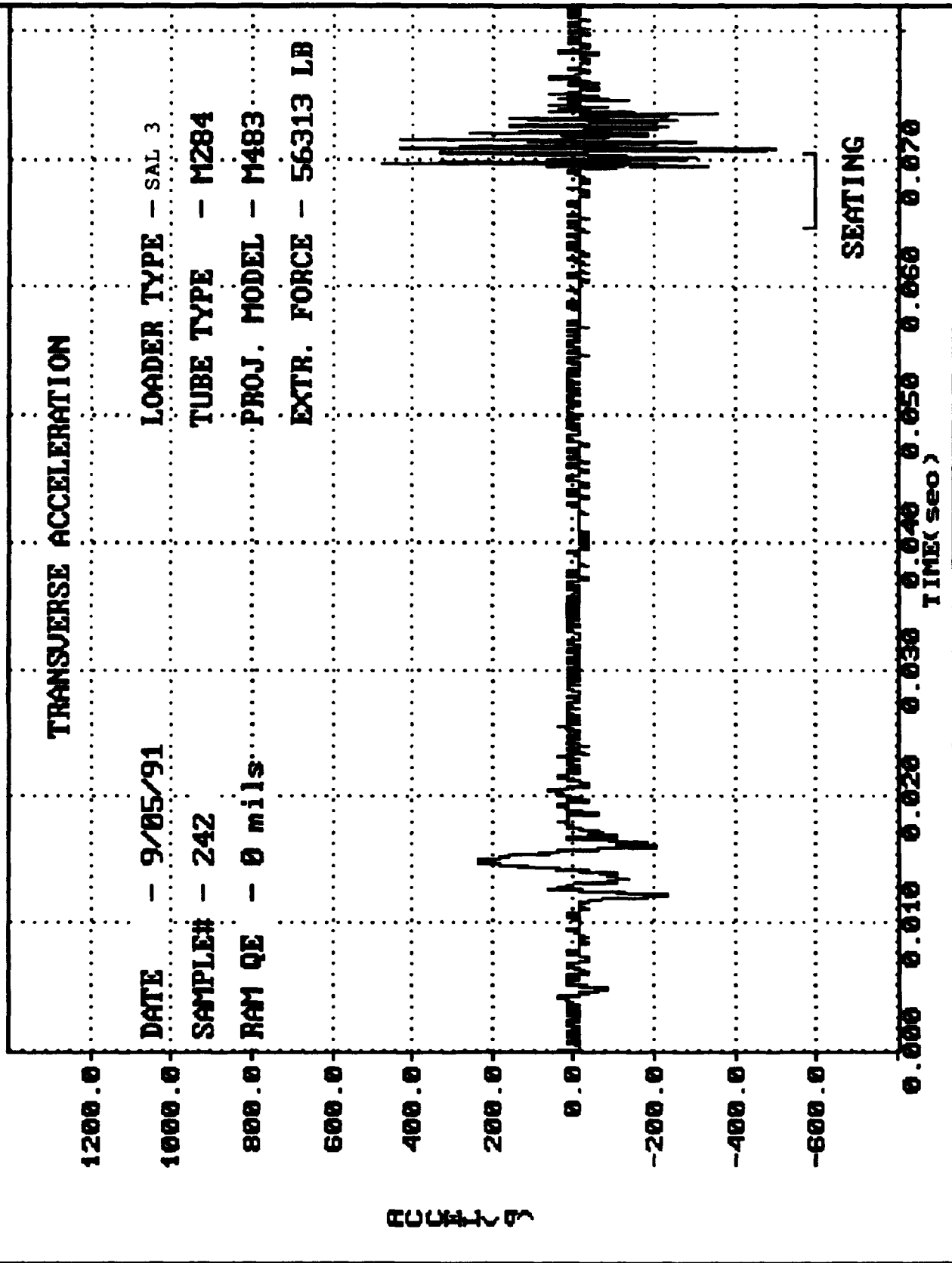
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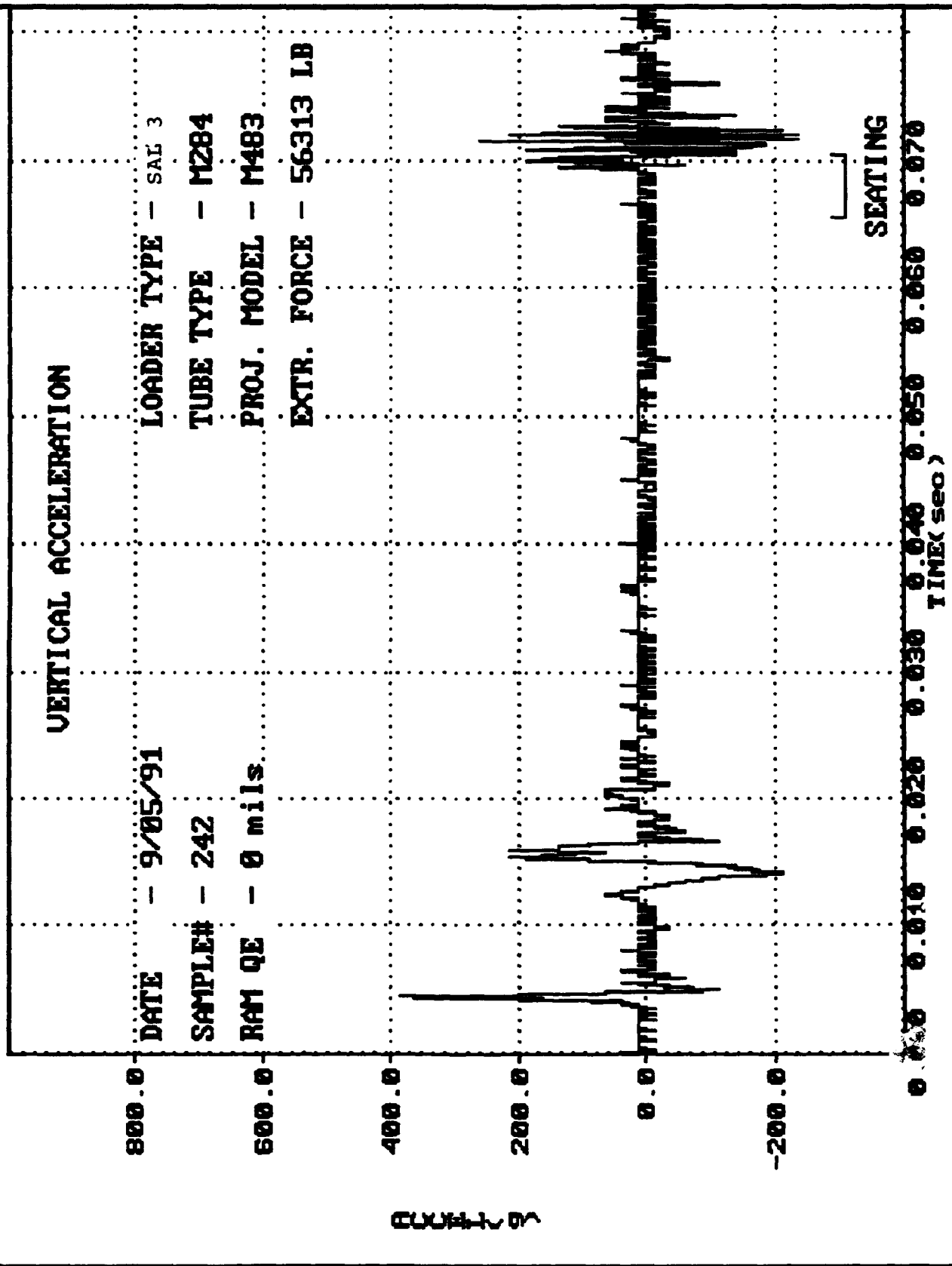
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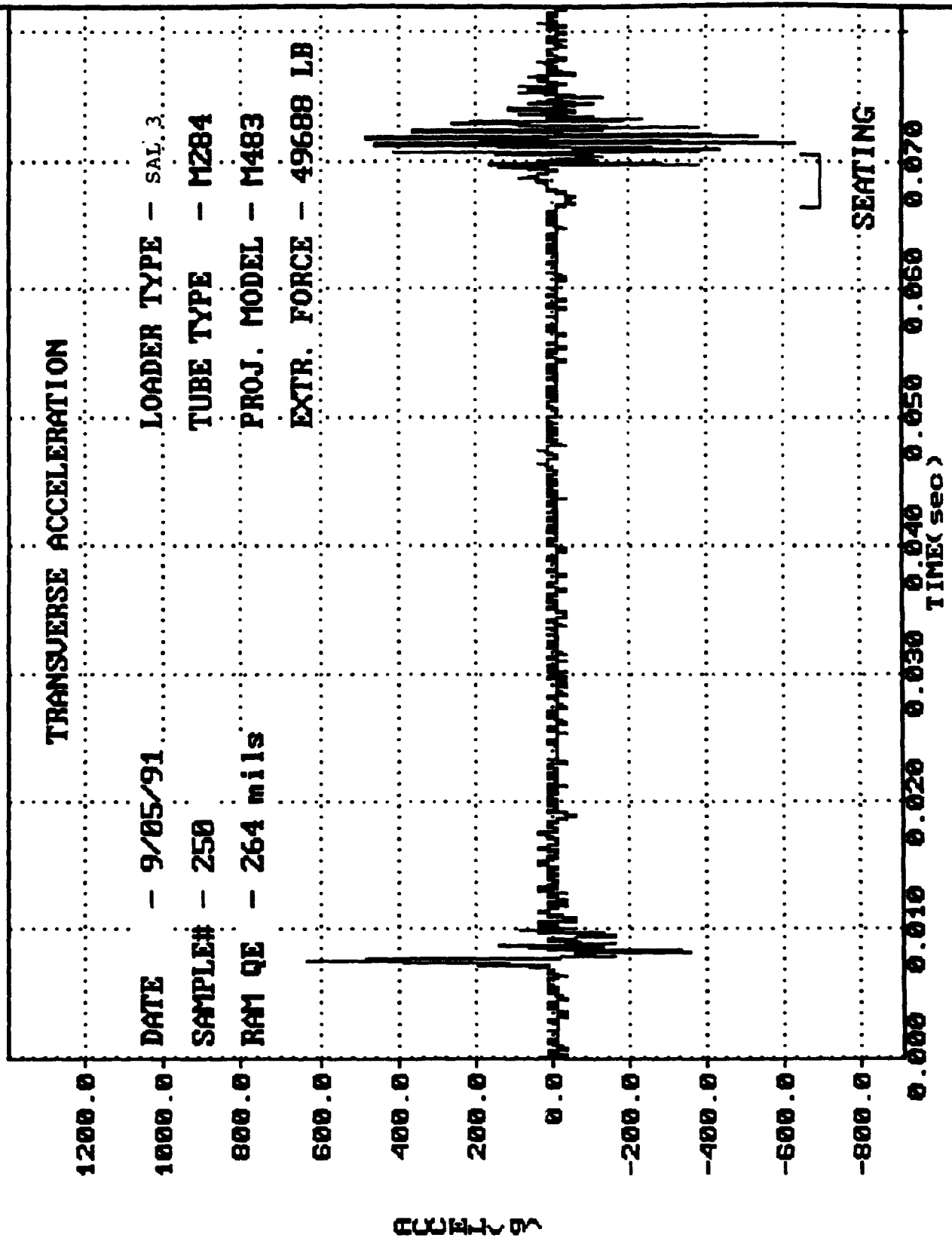


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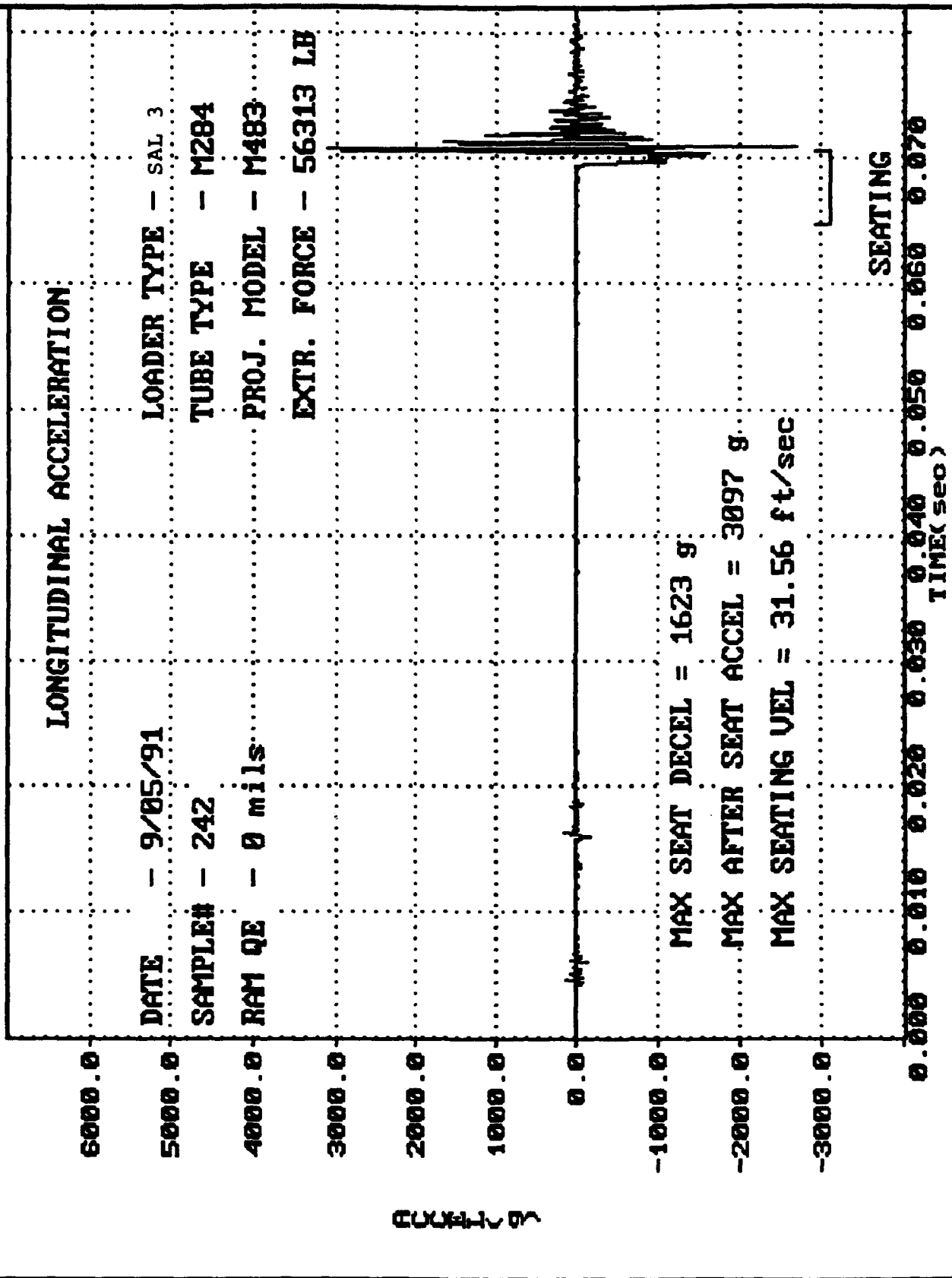




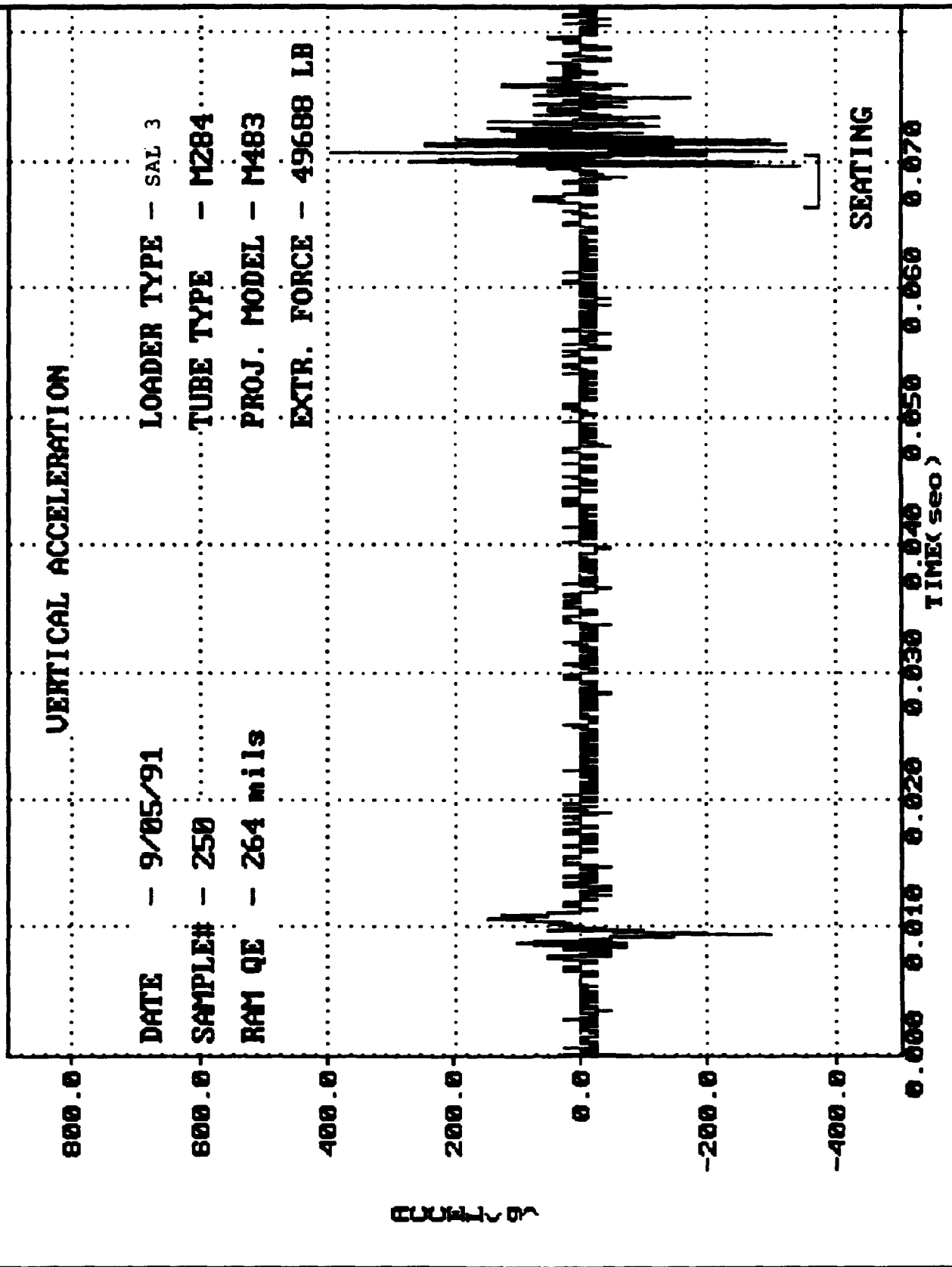
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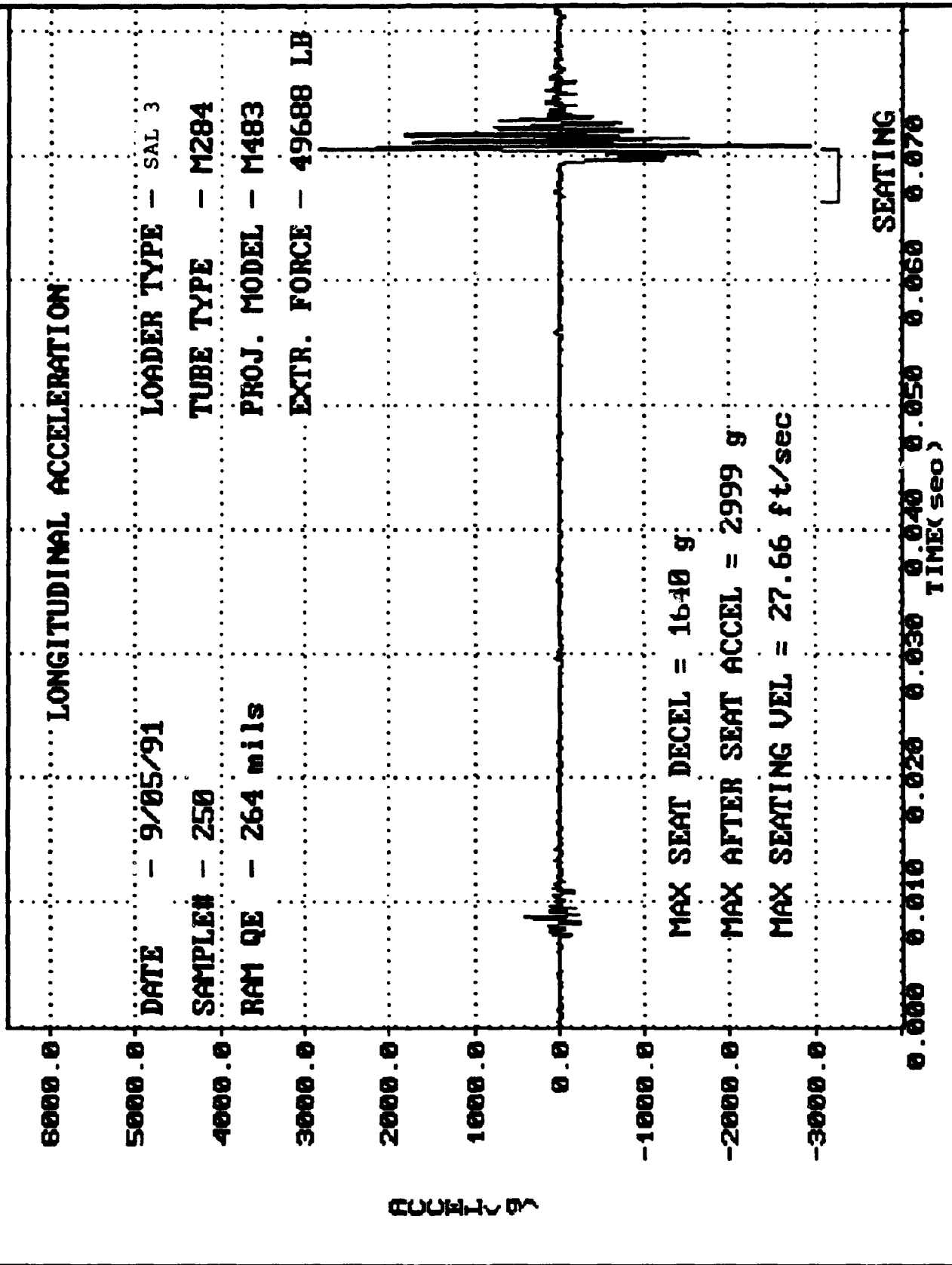
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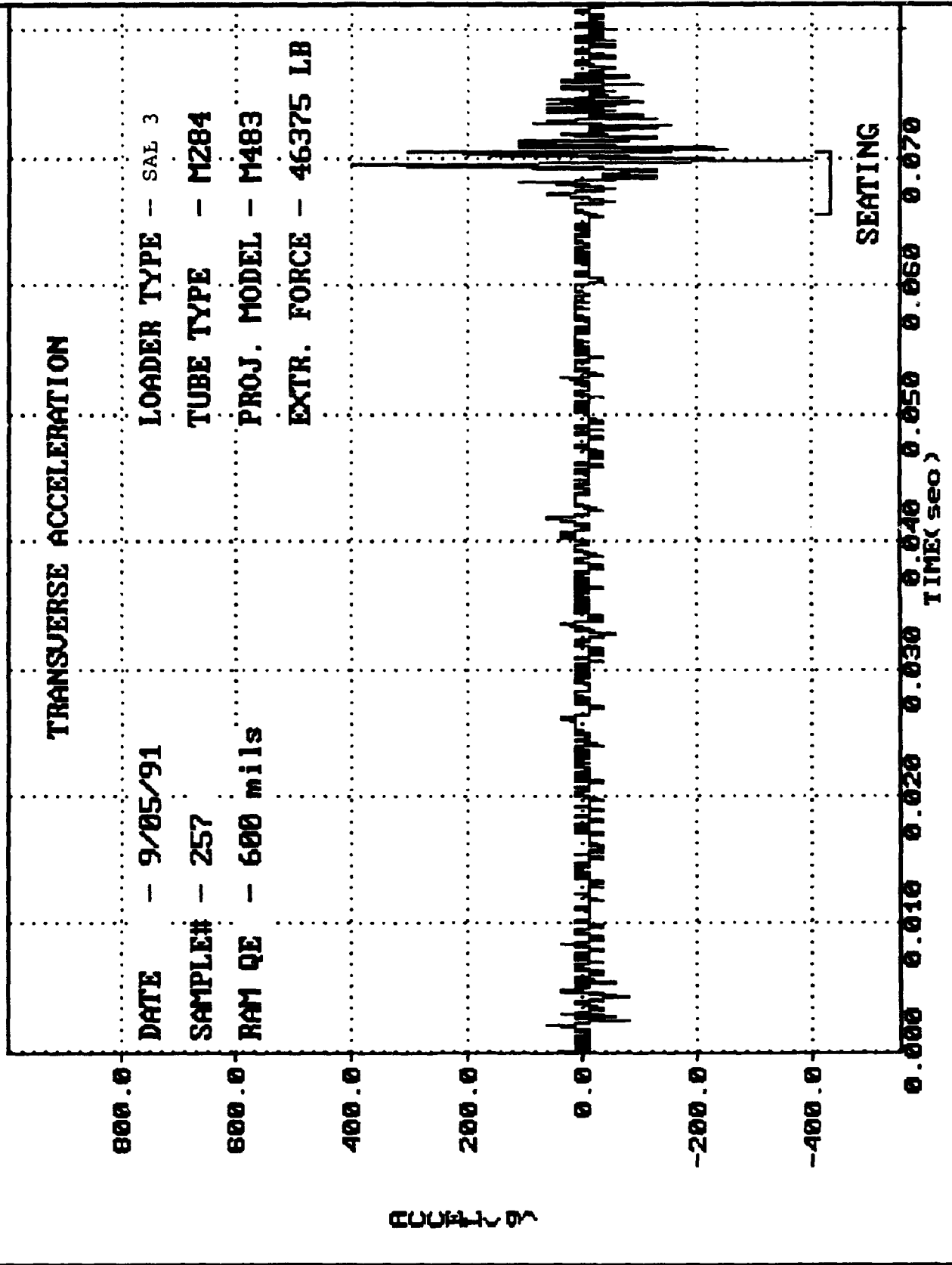
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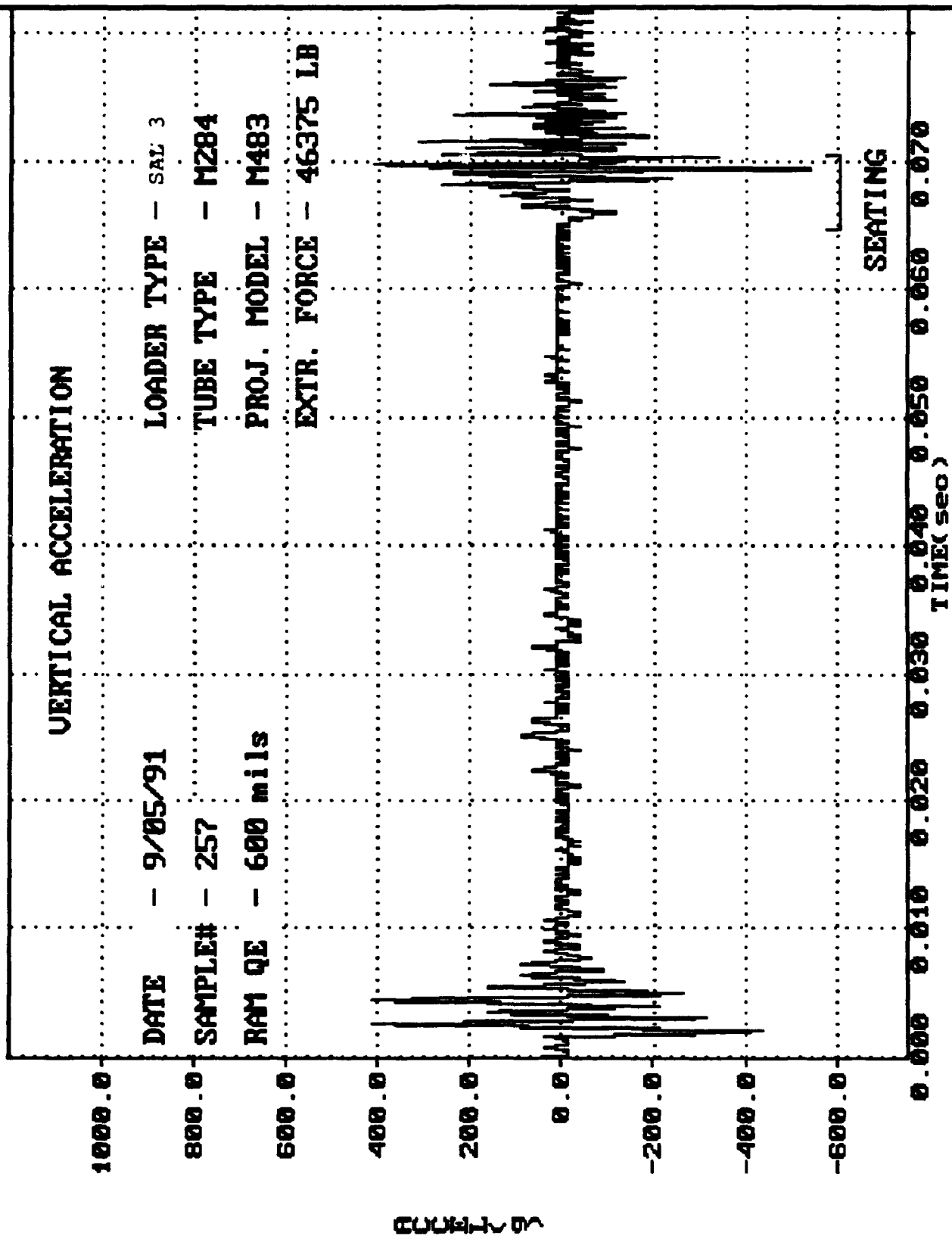
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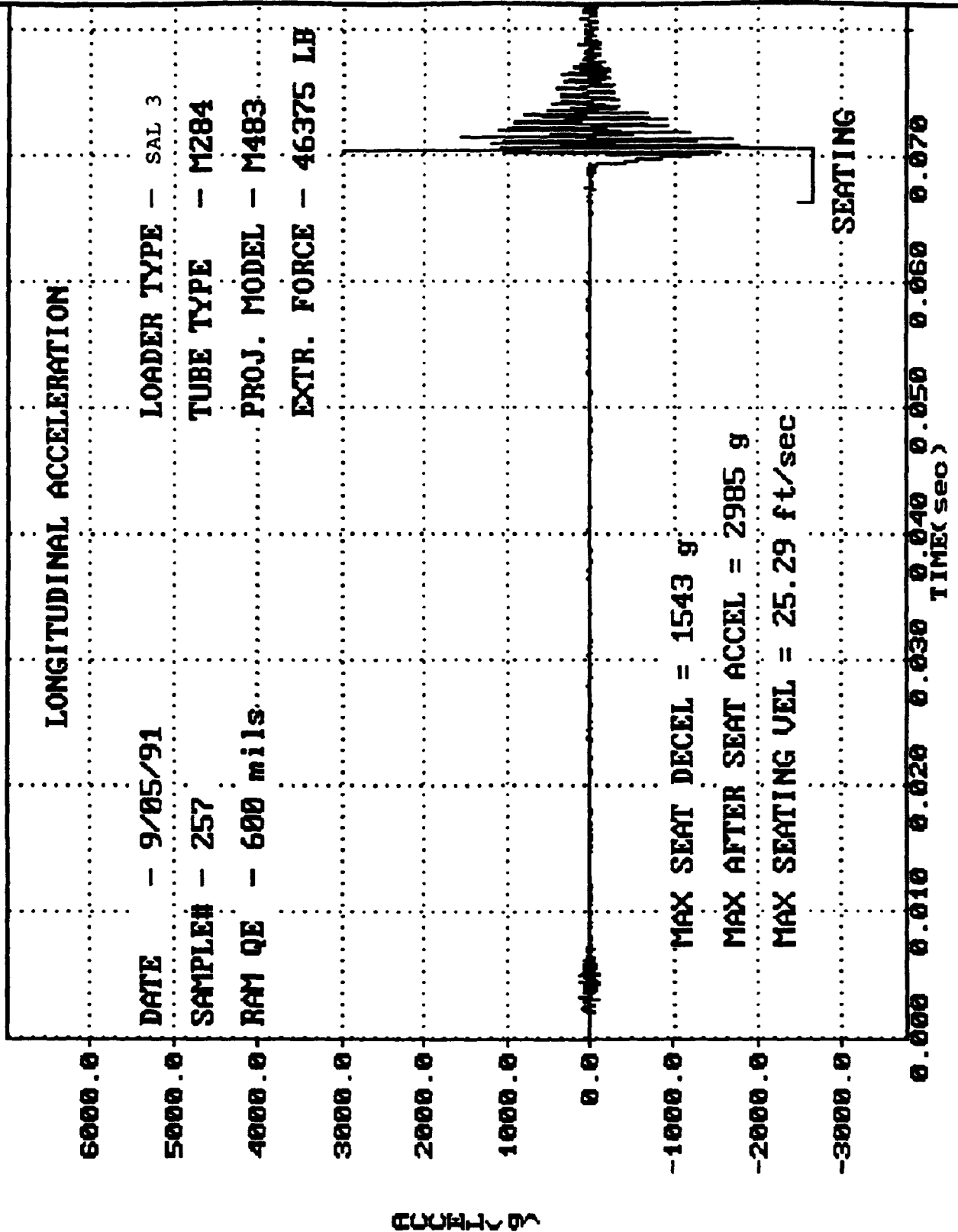
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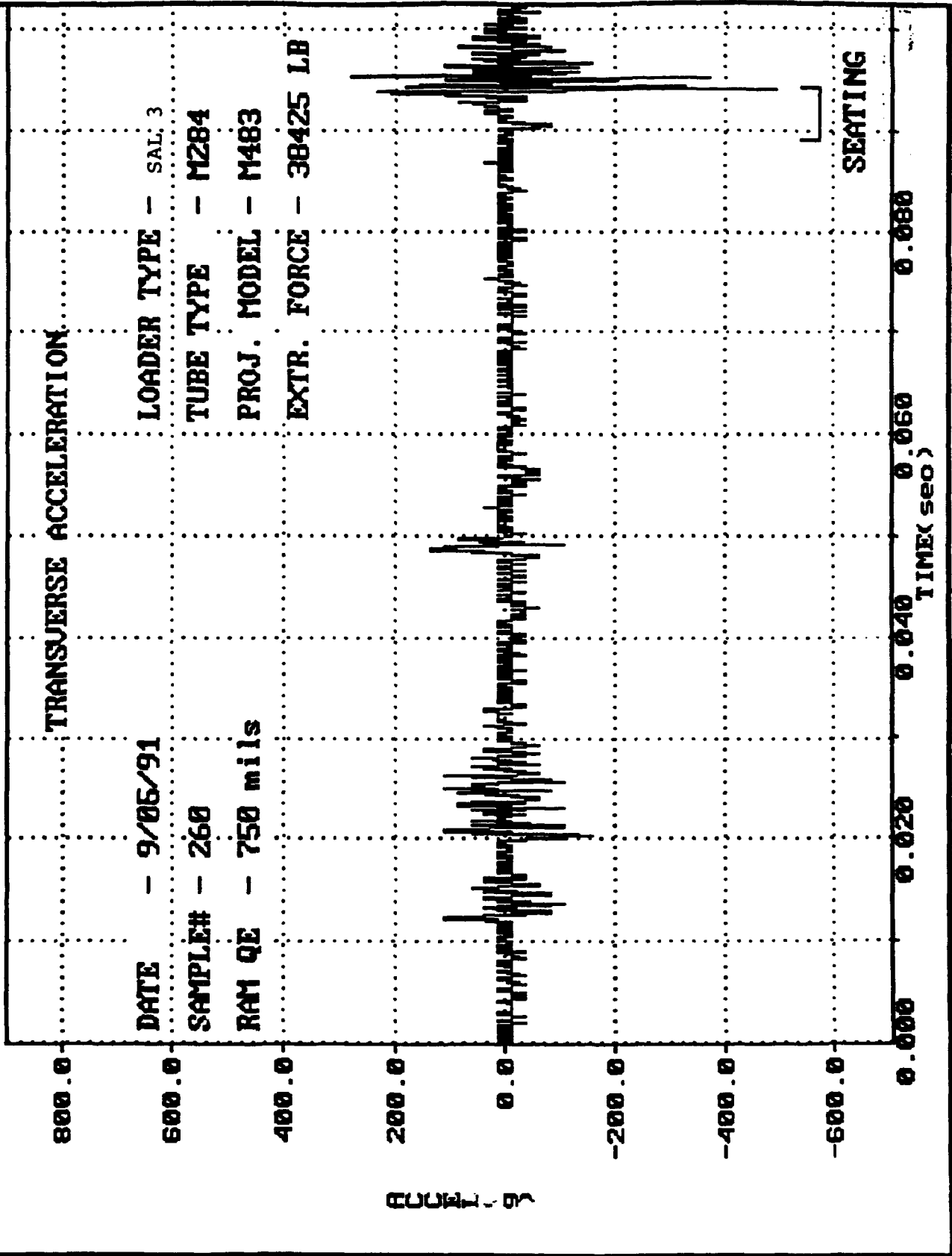
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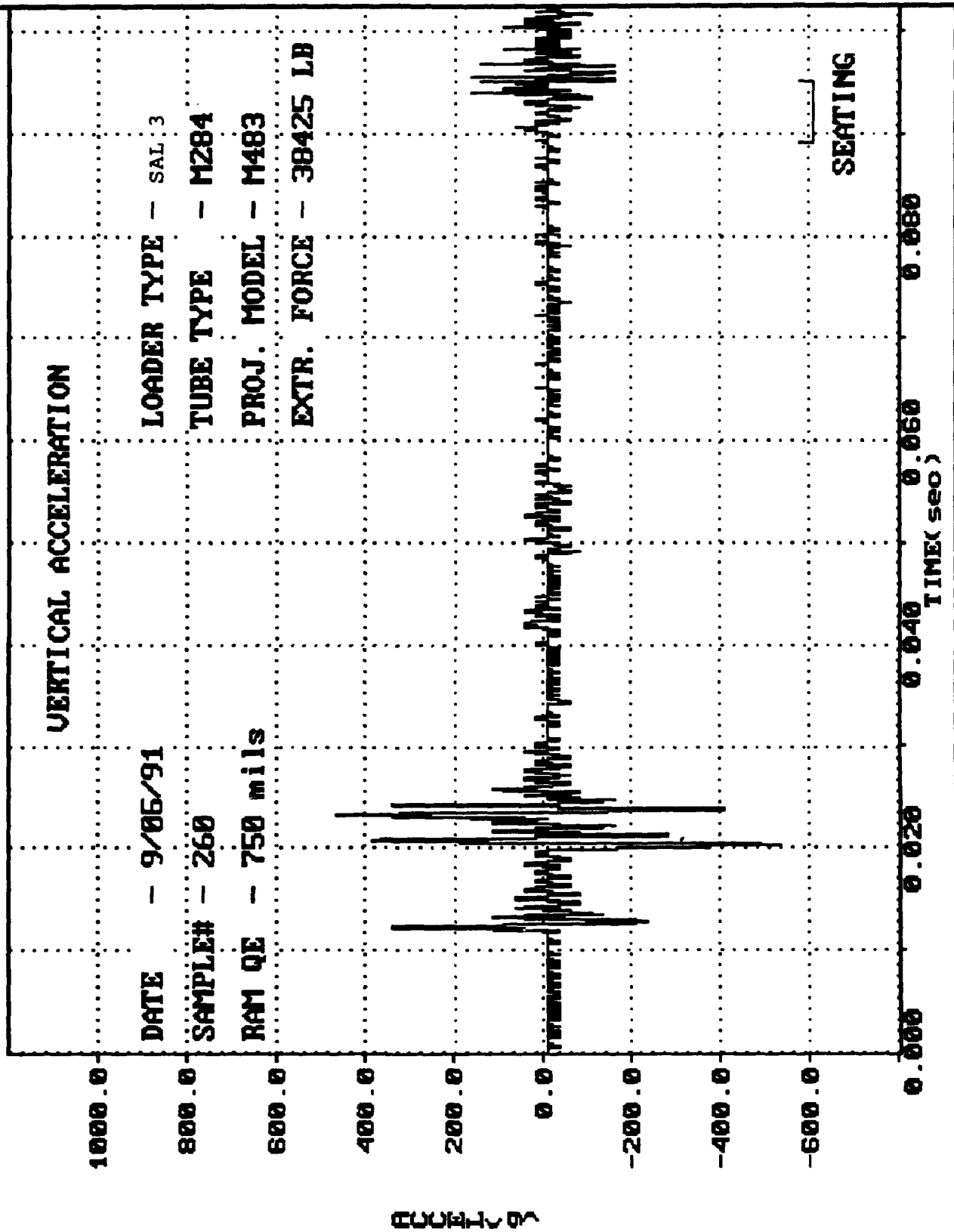


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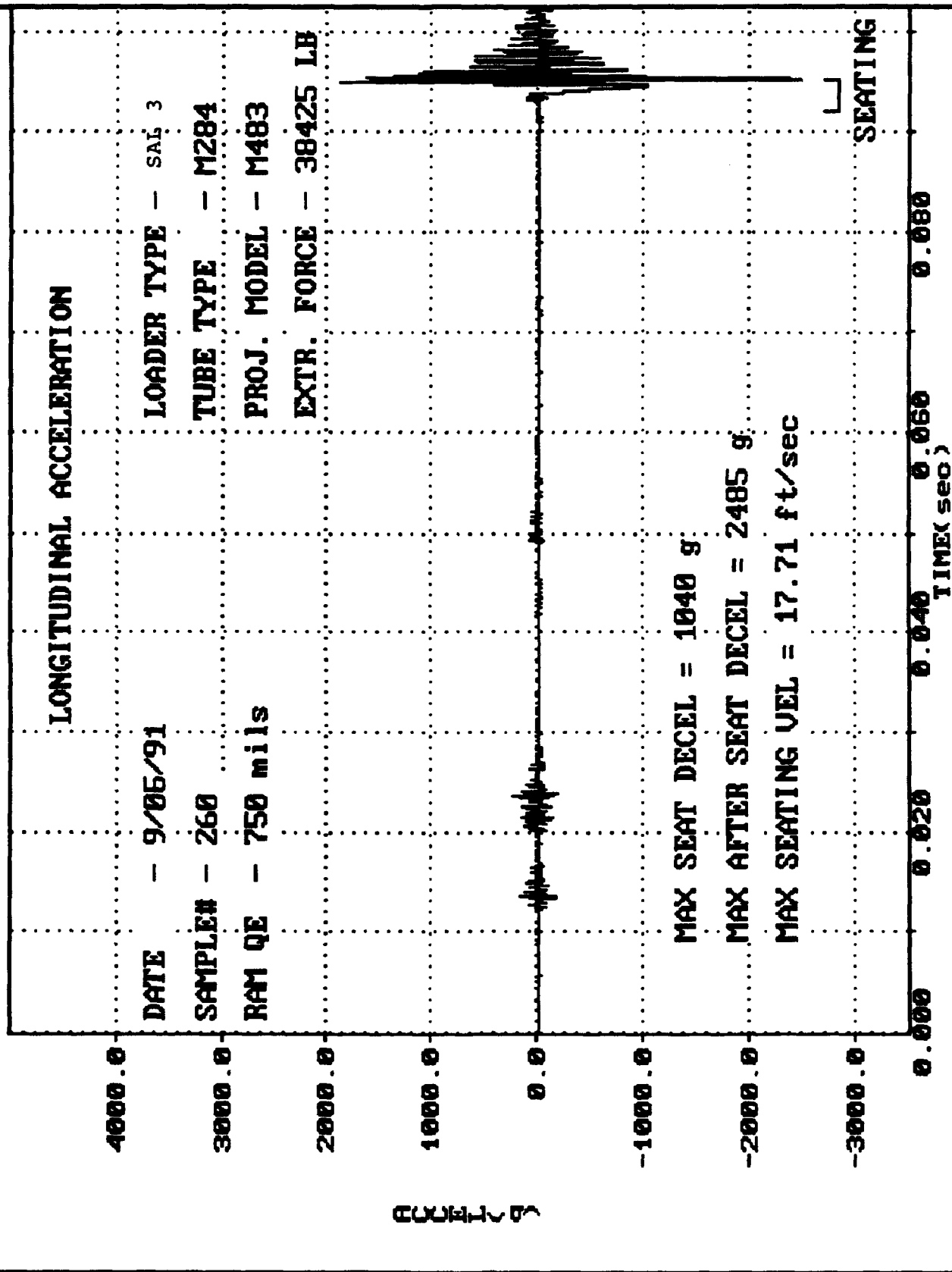




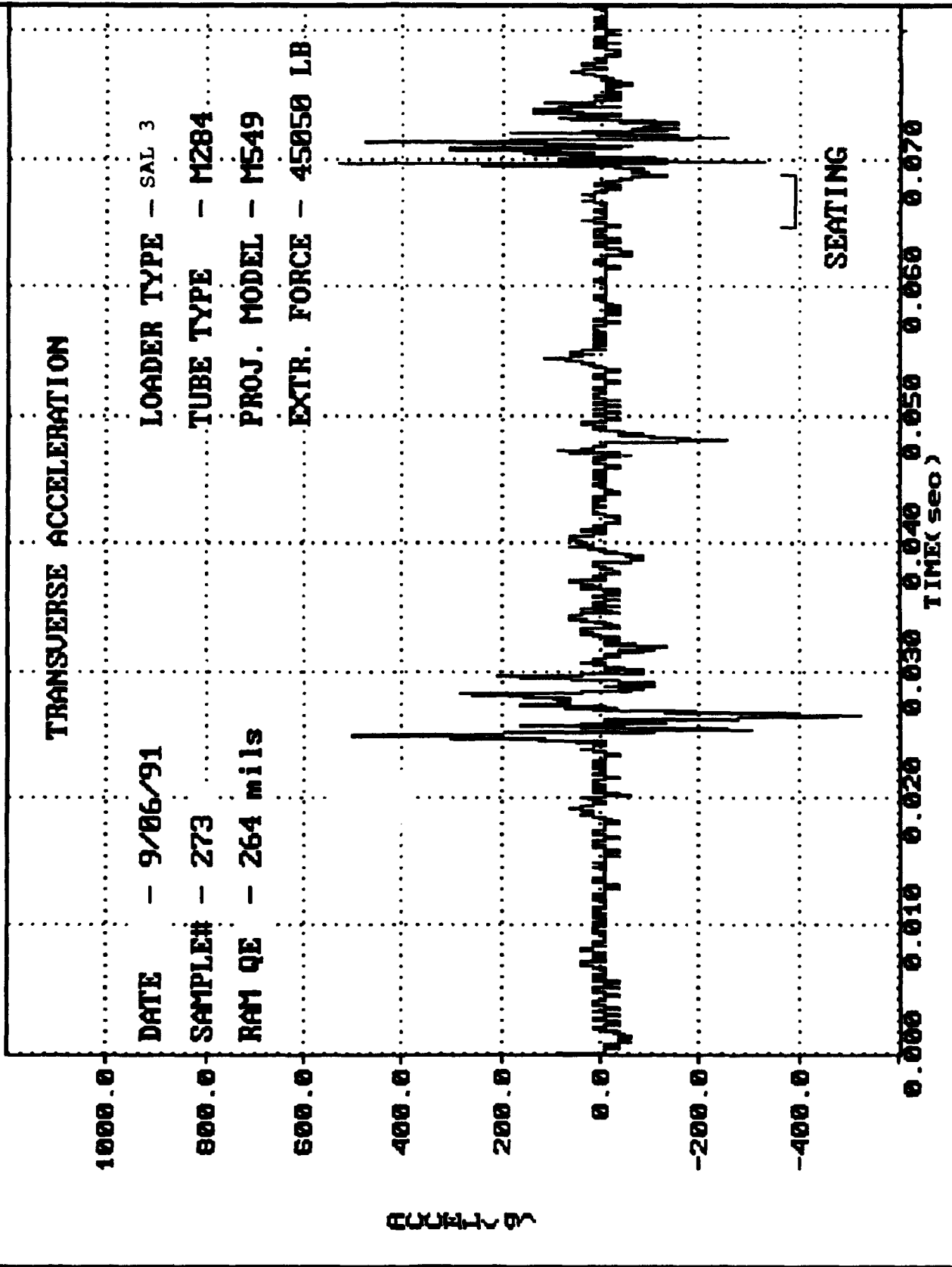
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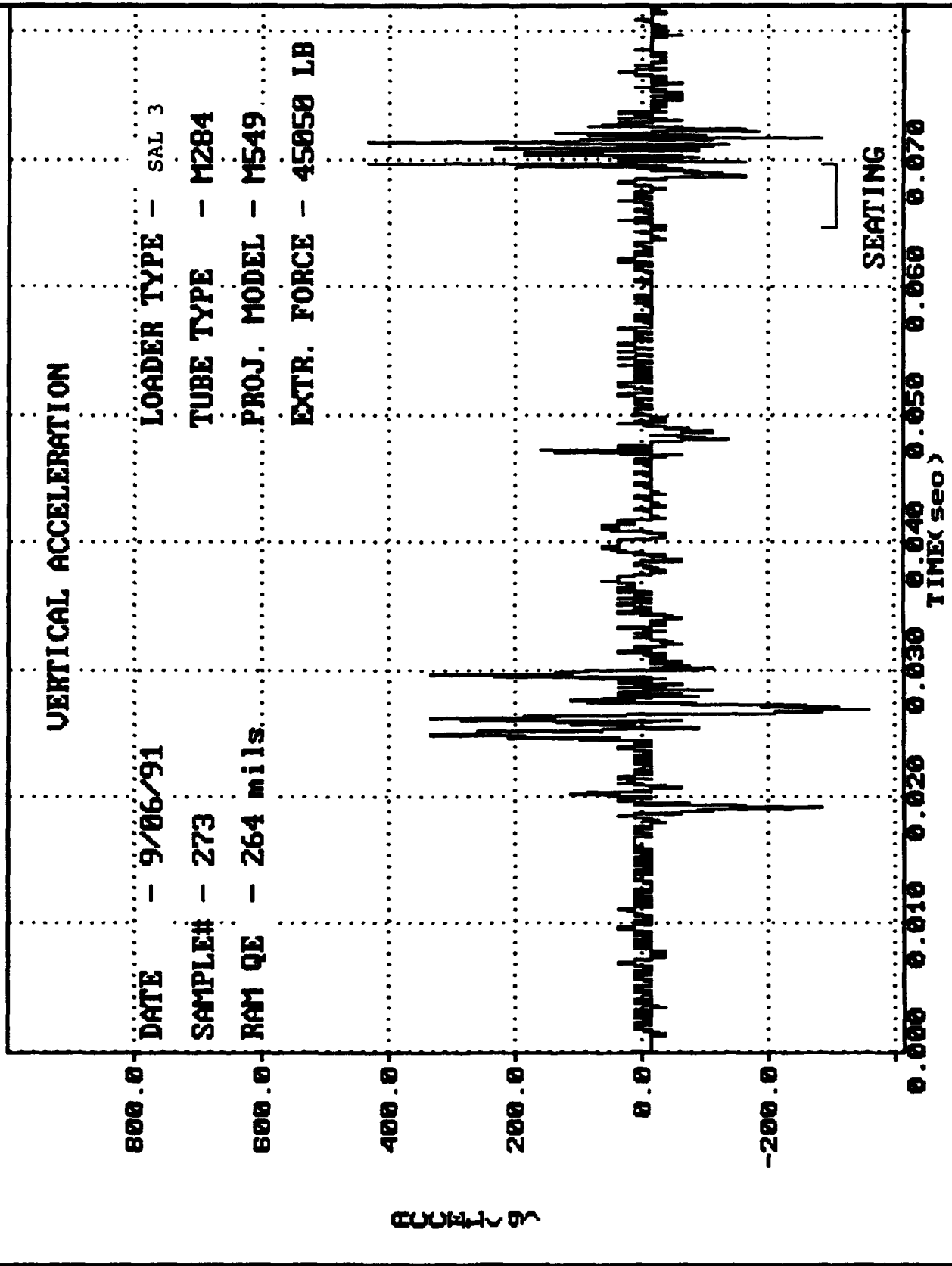
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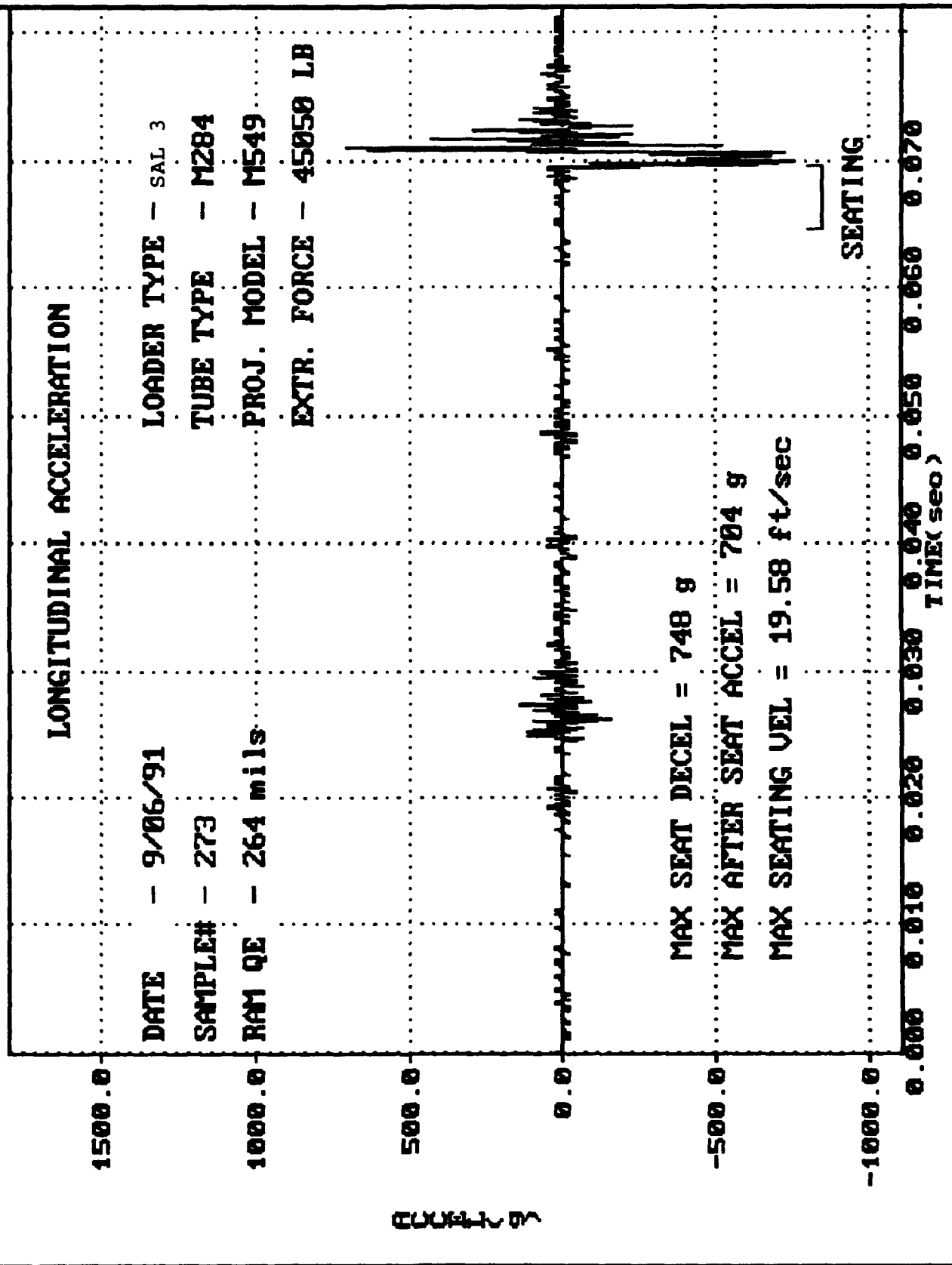
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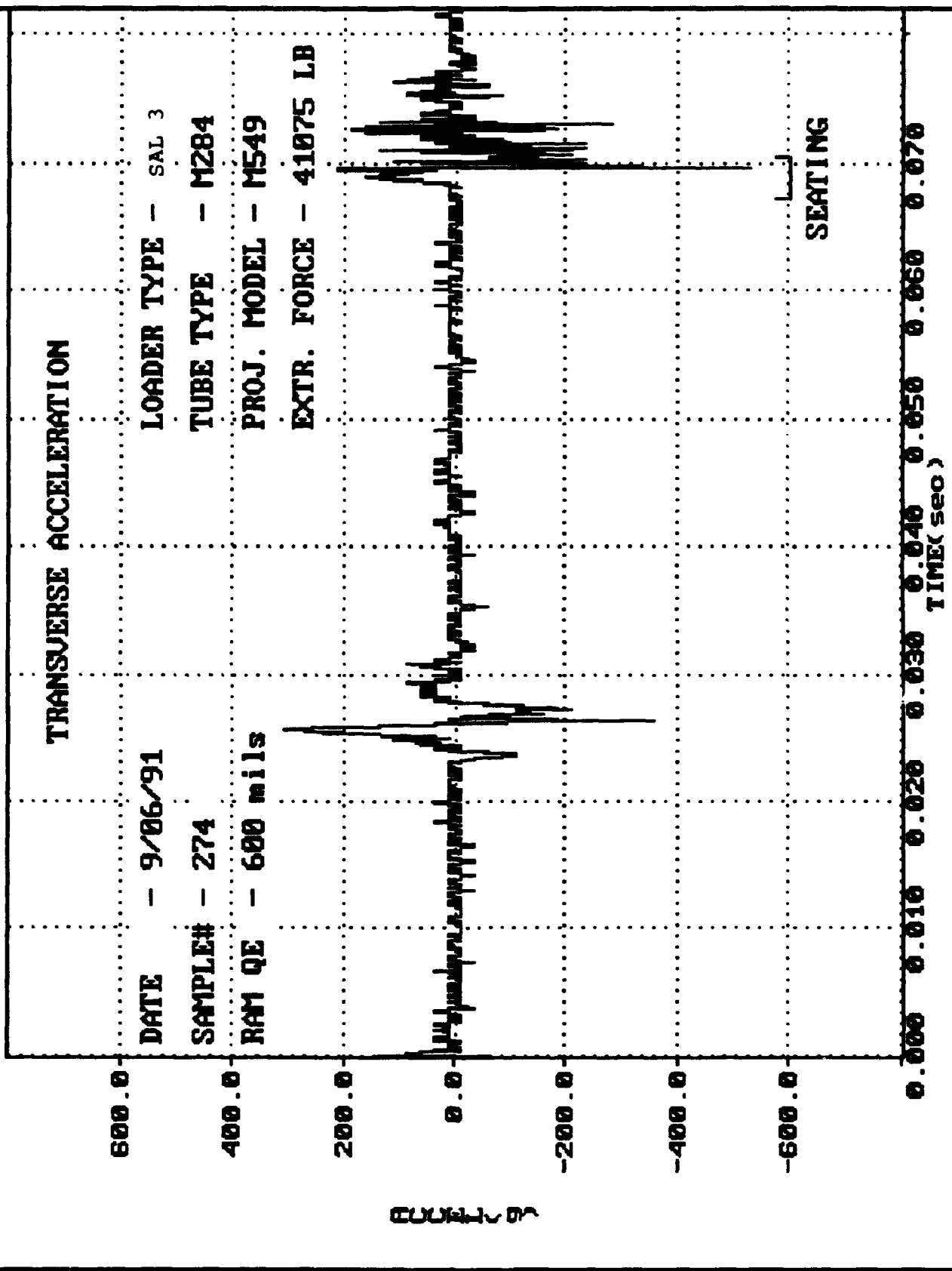
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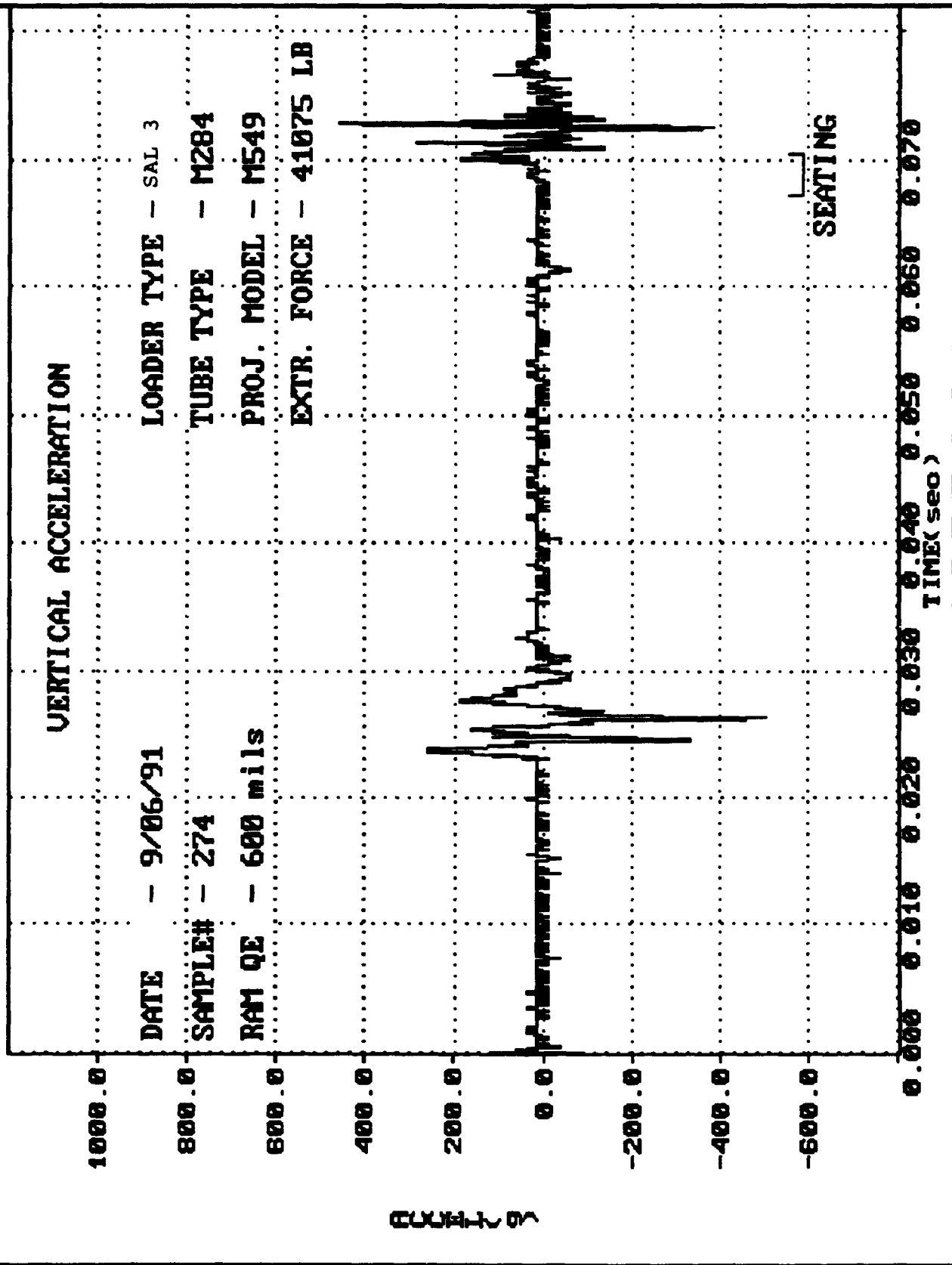
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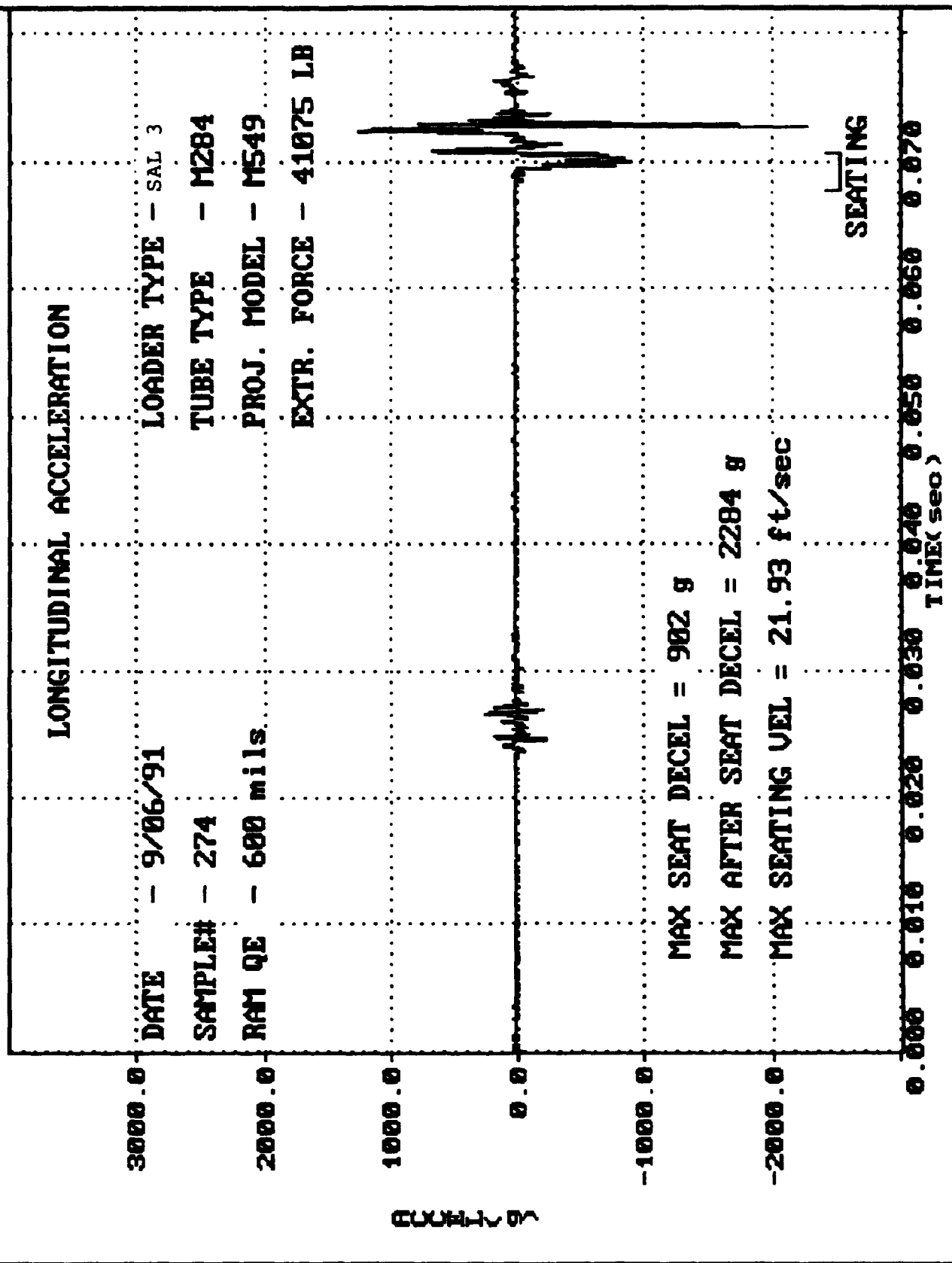
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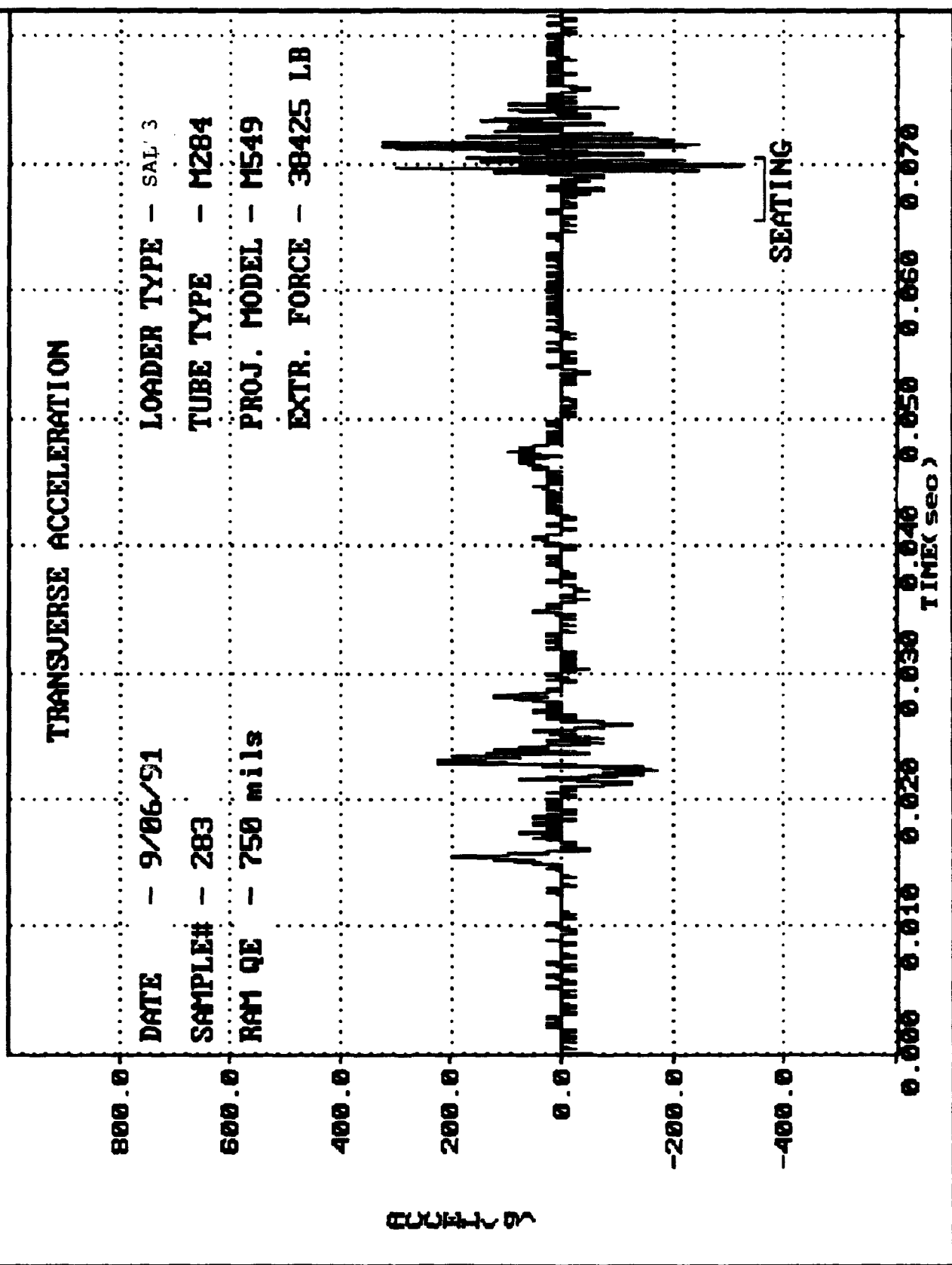


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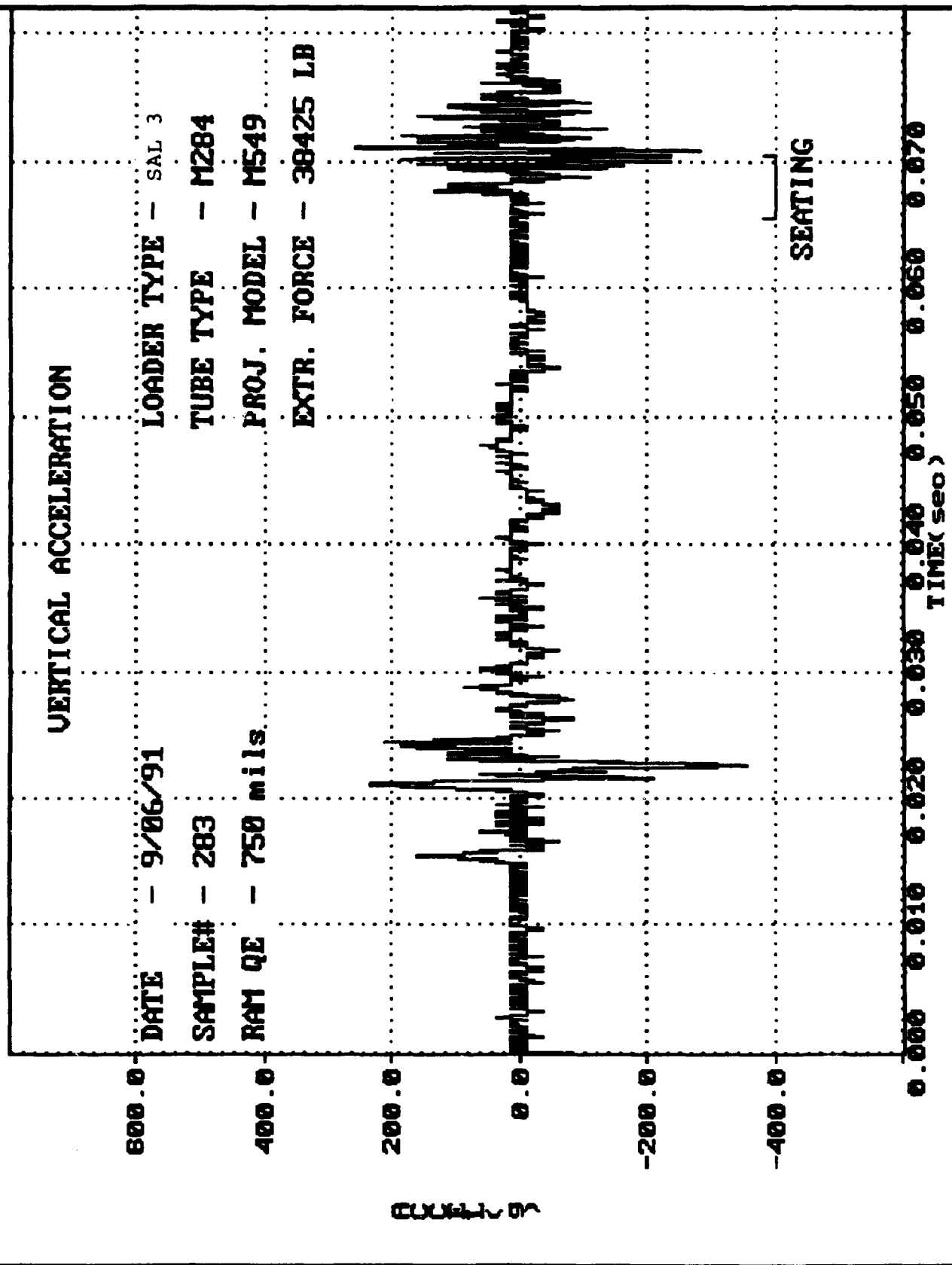




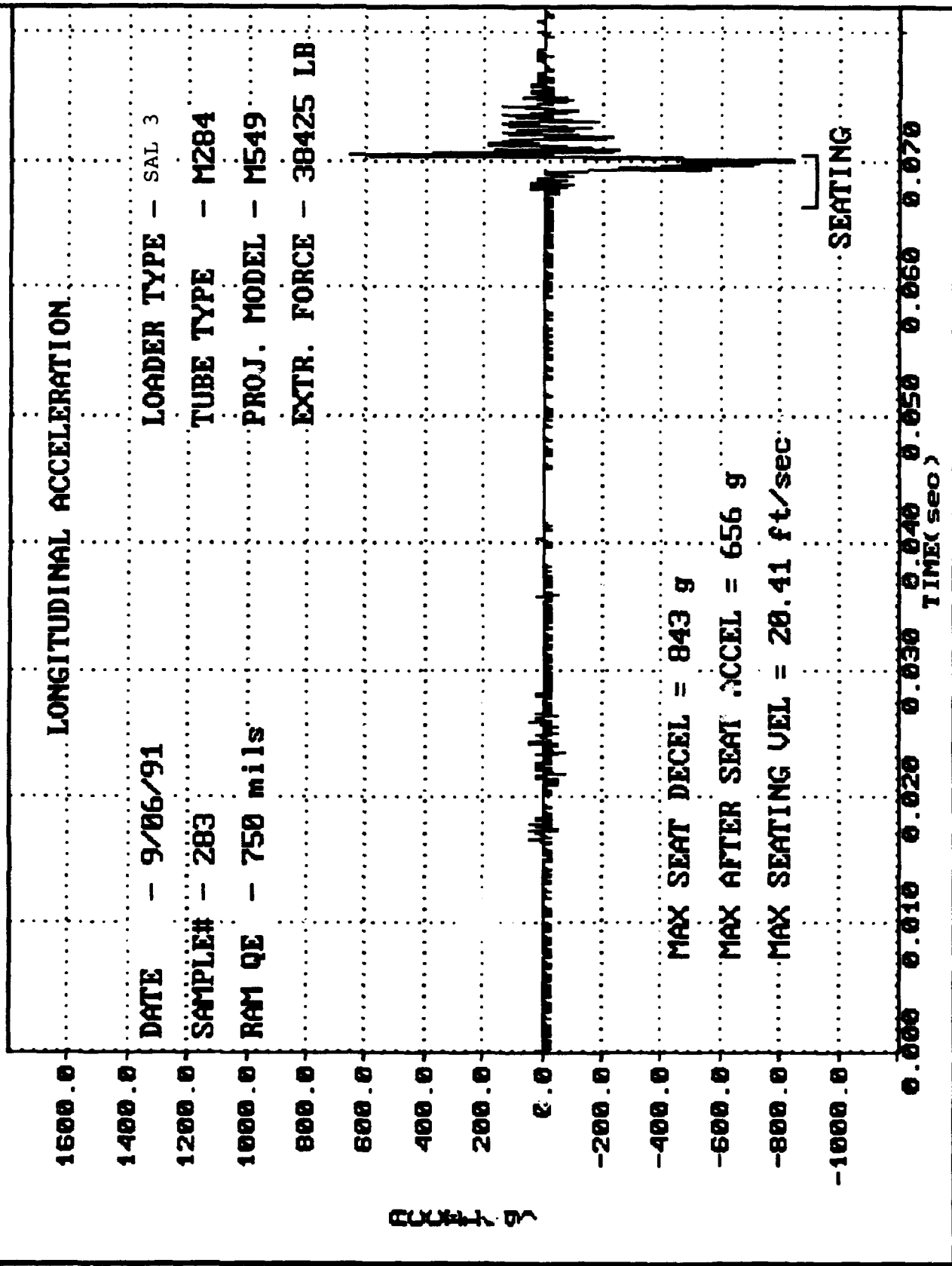
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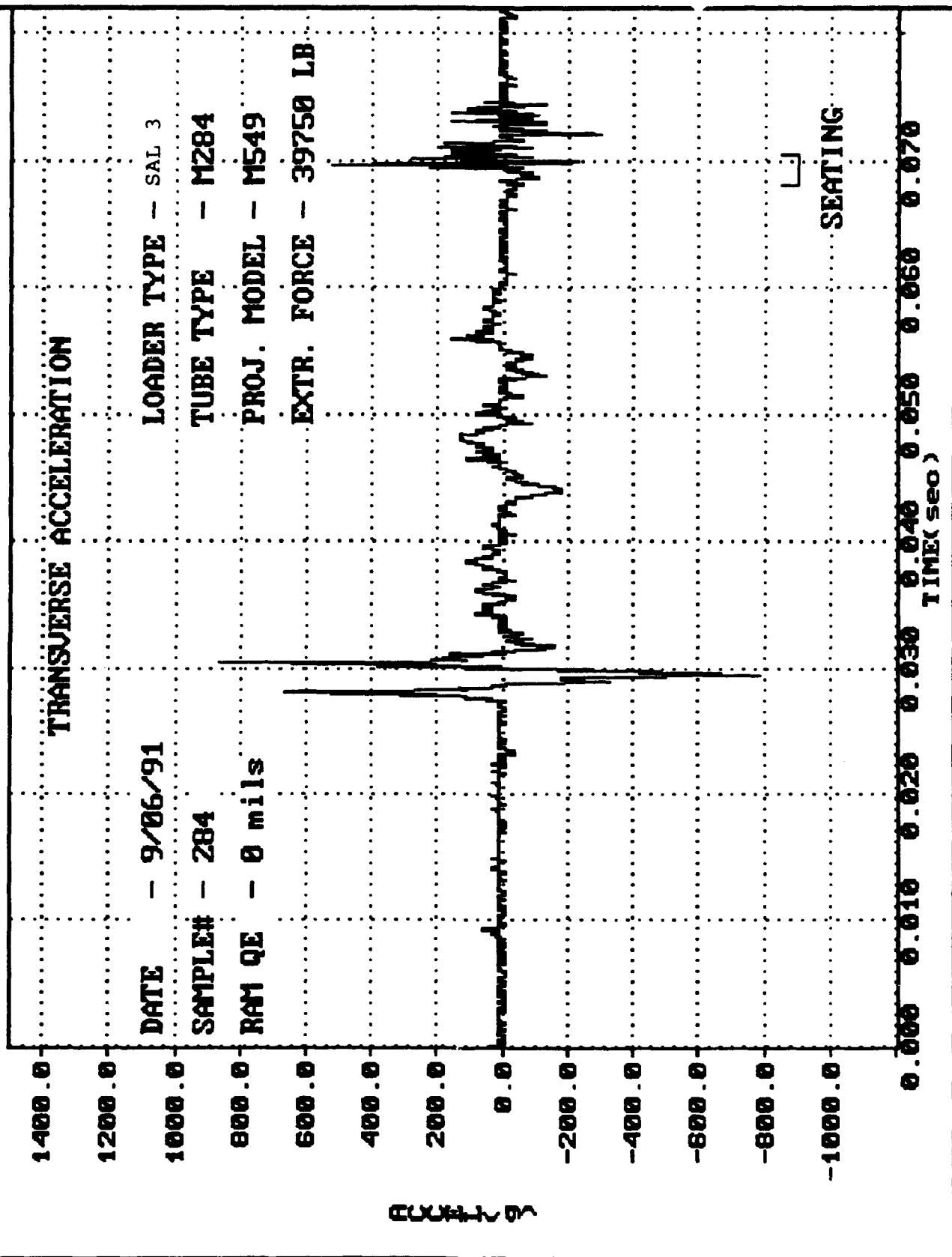
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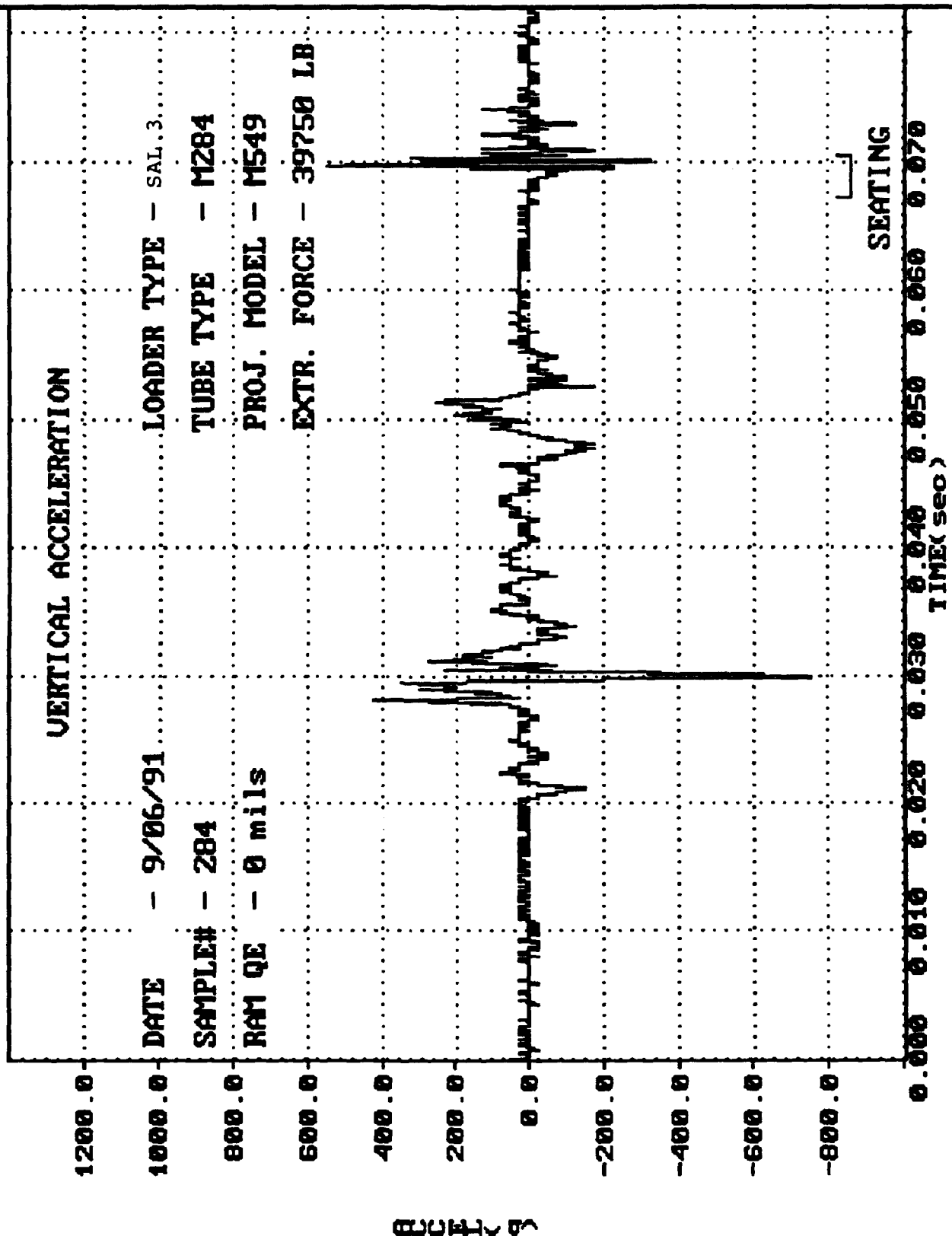
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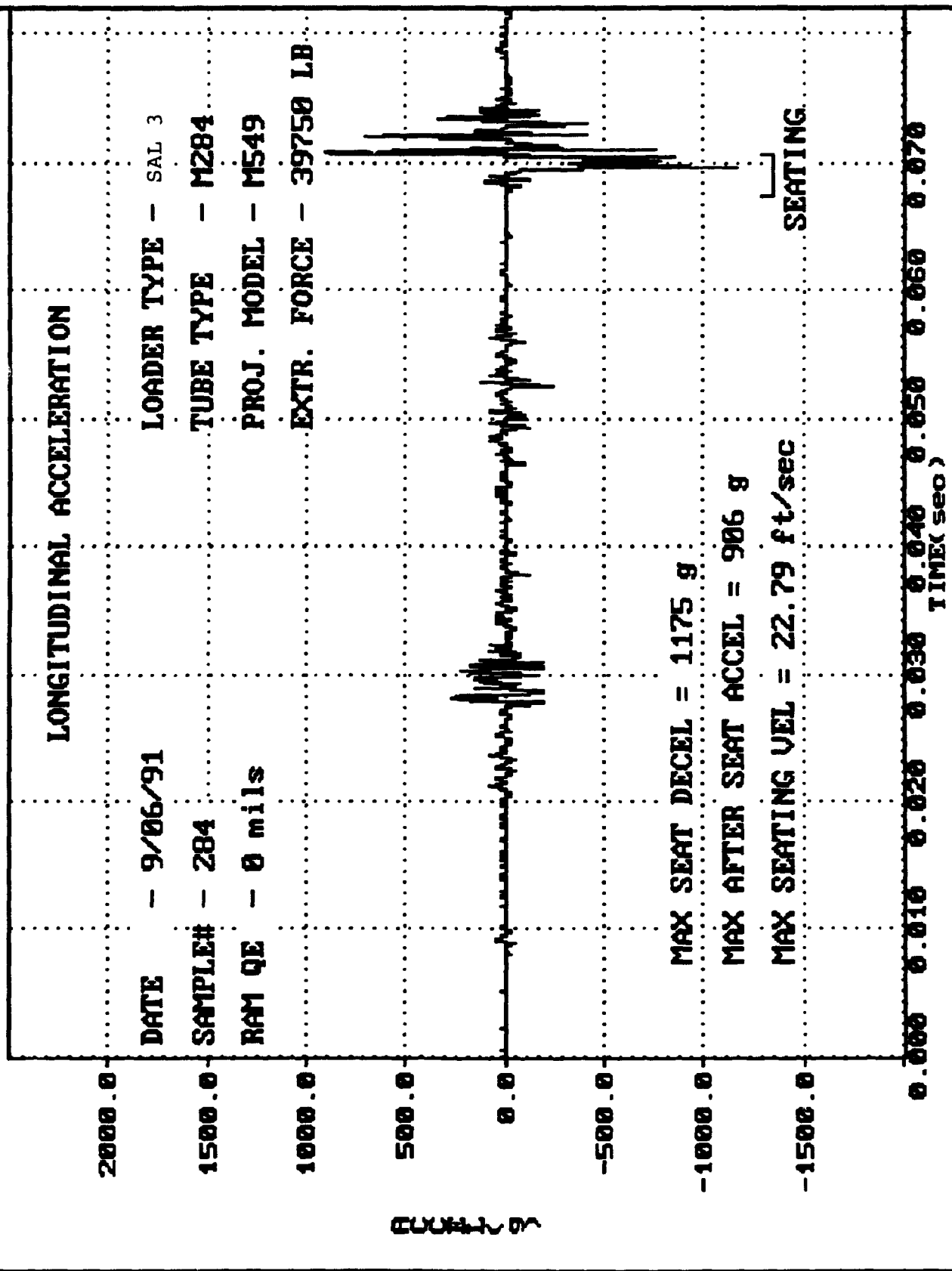
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Technical Report ARAED-TR-93026

## INSTRUMENTATION FOR THE FOREIGN WEAPONS EVALUATION PROGRAM

Joseph Petrellese, Jr.

April 1994

Approved for public release; distribution unlimited.

Replace the table of contents and the appendix cover sheets with the attached pages.

The author requests that you return the replaced pages to him instead of discarding them. An envelope is provided for your convenience.

May 1994

ERRATA AD A 279128

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APPENDIX B

SAL 1 RAMS

APPENDIX C

SAL 2 RAMS

APPENDIX D

SAL 3 RAMS